RAFFERTY-ALAMEDA PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Souris Basin Development Authority

CHAPTER 11

TRANSPORTATION

RAFFERTY/ALAMEDA ENVIRONMENTAL IMPACT STATEMENT

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TRANSPORTATION

The transportation system in any given area reflects the locations and intensities of various activities linked to the types of land uses in existence.

HIGHWAYS AND TRAFFIC

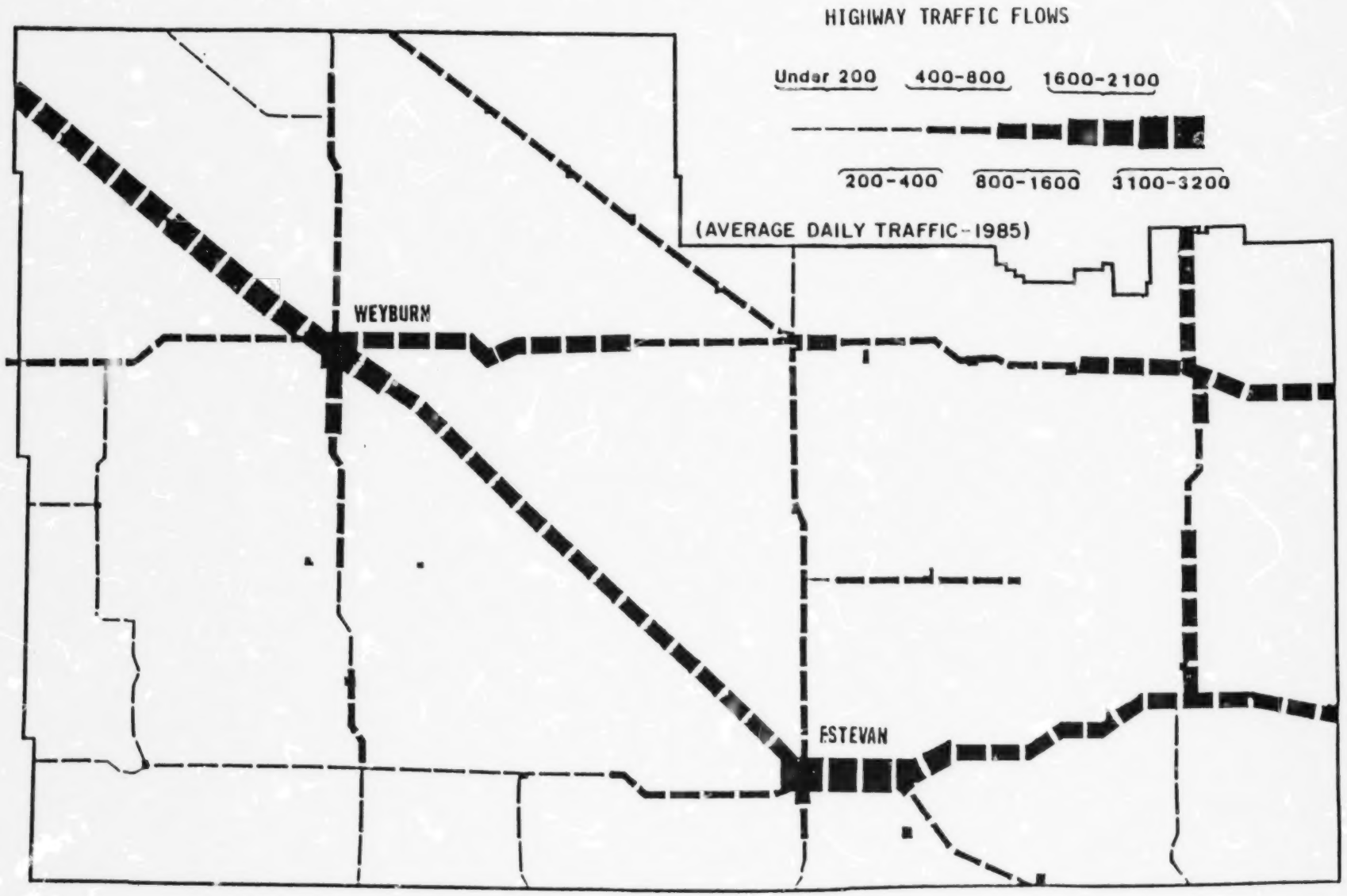
Saskatchewan Highways and Transportation publishes an annual Traffic Volume Map showing average daily traffic counts at numerous locations in the province. Data pertaining to traffic volumes in the Weyburn-Estevan area have been extracted for the years 1979 to 1985.

Examination of the traffic volumes at the various locations indicated there was not a pattern of consistent growth in highway traffic volumes in the area. Most locations showed indications of increased regional traffic volume yet only a few locations showed consistent growth. The most noticeable declines in traffic volumes occurred from 1981 to 1982, indicating a probable correlation with general economic conditions which translates into the effects of reduced activity in the oil industry.

Figure 1 depicts relative volume of highway traffic flow in the area surrounding Rafferty/Alameda sites. The two major destinations are Weyburn and Estevan. Weyburn is located at the intersection of 3 provincial highways: No. 35 (north-south), No. 13 (east-west) and No. 39 (northwest-southeast). (Refer to Figure 1 for location of highways.) No. 39 is the dominant route as it connects Regina and Estevan. As of 1985, the six highway routes leading in and out of Weyburn had a combined average daily traffic of 9,670 vehicles. About 49 percent occurs on Highway #39 with the remainder roughly split between Highway 35, 22%, and Highway 13, 30%. Highway 13 to the east has the third highest traffic with a daily average of 2,050 vehicles. Highway 35 south is next at 1,200 vehicles followed by Highway 35 north with 900 vehicles and Highway 13 west with 820 vehicles.

Estevan has five provincial highways leading to and from the city as a result of the intersection of Highways 18, 39, and 47. Highway 39 comes in from the northwest, Highway 18 from the west, and they combine to the east from Estevan to Bienfait where they again separate. The combined average daily

FIGURE 1


HIGHWAY TRAFFIC FLOWS
Under 200
400-800
1600-2100
200-400
800-1600
3100-3200
(AVERAGE DAILY TRAFFIC-1985)
WEYBURN
ESTEVAN

traffic of these routes was 8,650 vehicles in 1985. Of this total, Highway 39/18 east had 3700 vehicles (43%) followed by Highway 39 from the northwest at 1,900 vehicles (22%).

The centrality of Weyburn and Estevan can be put into context by comparisons to both larger and smaller centers. Regina, for example, has six major highway routes in/out of the city with a combined traffic volume of 40,500 vehicles. Moose Jaw has 5 routes and 15,690 vehicles on average.

With respect to smaller centers in the area, both Oxbow and Carlyle are at or near the intersection of two highways and have similar traffic volumes (Table 1). Radville, which is similar in size to these two centers has about one fourth the traffic volume.

Overall, the highway system (and corresponding community system) in Saskatchewan has developed on a mutually dependent basis. Larger centers initially grew on the basis of inter-community rail-accessibility. To a great extent, the highway system mirrored the rail system but having more flexibility, developed additional routes between major centers. The increase in relative accessibility due to the highway network provided larger centers with a locational advantage when rural populations became more mobile and began to bypass smaller centers for some of their needs.

TABLE 1
Average Daily Highway Traffic at
Selected Locations, 1985

Center	Number of Highway Routes in/out of Center	1985 Combined Average Daily Highway Traffic
Weyburn	6	9670
Estevan	5	8650
Oxbow	4	4780
Carlyle	4	4220
Radville	3	1270
Stoughton	5	3640
Alida	3	700
Oungre	4	1620
Carnduff	3	2505
Torquay	3	1115

Source: Travel on Saskatchewan Highways 1985,
Saskatchewan Highways and Transportation.

RURAL ROADS AND TRAFFIC

The open country is criss-crossed by a network of rural roads. Over the years it has become a reflection of the original survey system, with a heirarchy based on the pattern of travel in rural areas. In many respects, this rural road network serves as a collector system for the highway network.

The hierarchy of rural roads is classified according to standards of construction (based on amount and type of traffic). The types of roads are:

- Provincial Roads
- Primary Grid (paved, graveled)
- Grid (paved, graveled)
- Main Farm Access
- Resources Development Road
- Farm Access

There are few Provincial Roads; most are built and maintained by Rural Municipalities. The Primary Grid network is essentially a higher level collector system for urban-oriented traffic. Grid roads are less travelled collectors. Main Farm Access roads provide access to the dispersed farmsteads.

The organization of the road network in any given area generally reflects the local level of economic activity. Traffic flow maps for the five Rural Municipalities in the Rafferty Project Area are presented in Figures 2 to 6 inclusive. Maps for the two Rural Municipalities in the Alameda Project Area have also been included (Figures 7 and 8). The traffic patterns in each R.M. are discussed below. (These maps, from Saskatchewan Rural Development, are intended to be updated in 1987 with current traffic flow data.)

RAFFERTY RESERVOIR AREA

.1 R.M. Estevan No. 5

The City of Estevan is located in the central portion of this R.M. Given the five highway routes leading to/from the city, the Souris River, and Boundary Reservoir, there is no well-integrated rural traffic pattern. Most of the rural roads are quite obviously collectors for the highway system or destination

TRAFFIC FLOW MAP

FIGURE 2

R.M. OF ESTEVAN NO. 5

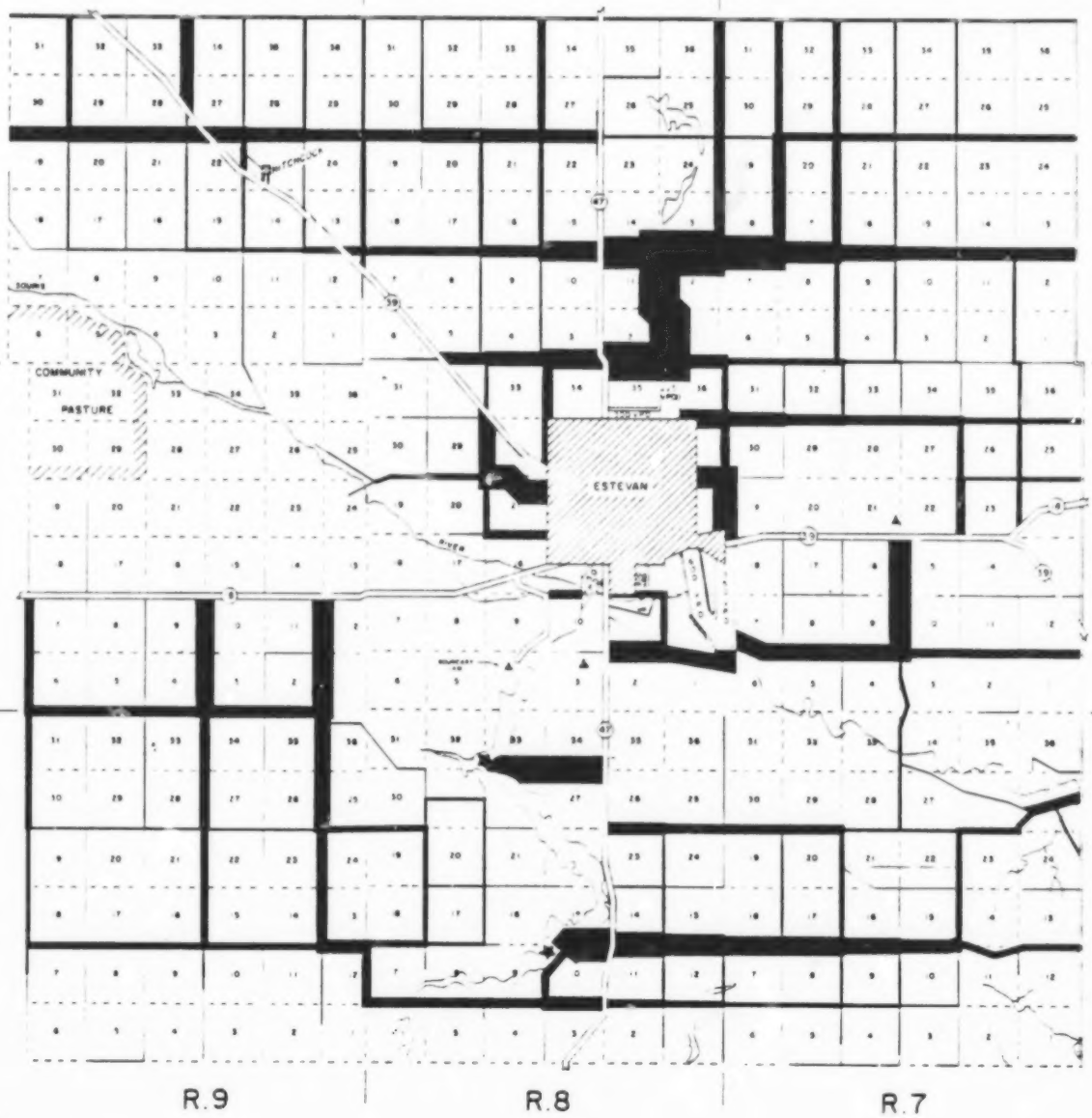
W. OF 2ND

LEGEND

5
25
50
75
00

AVERAGE ANNUAL DAILY TRAFFIC

982



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routes for sites around Estevan. Note the general absence of roads across the Souris valley, especially west of Estevan.

.2 R.M. Cambria No. 6

Cambria R.M. is located immediately to the west of Estevan R.M. and is dissected by Highway 18 from east to west as well as Highway 350 from the village of Torquay south to the U.S. Border. The Souris River cuts across the northeast corner leaving one-half of a township north of the River. Long Creek cuts across the southwest corner. The heaviest travelled rural road is the Primary Grid running north from Torquay past Dr. Mainprize Regional Park and north to Halbrite or Midale. Traffic on this road in 1983 was 150 vehicles per day just north of Highway 18, declining to 80 vehicles at the R.M. boundary. The main farm access road crossing the Souris River between Outram and Macoun to the north shows an average annual daily traffic volume of approximately 40 vehicles per day. Note there are no other year-round or improved roads crossing the Souris River in the municipality.

.3 R.M. of Cymri No. 36

Cymri R.M. is immediately north of Cambria R.M. It's dominant settlement features include the Town of Midale and the Villages of Halbrite and Macoun which are all located on Highway 39, running diagonally through the R.M. The Souris River cuts across the R.M. in the southwest where the Midale Community Pasture and Dr. Mainprize Regional Park are located.

The traffic pattern in the R.M. has two main features: first, the traffic flow on the Primary Grid #606 from Dr. Mainprize Park is up to 300 vehicles per day in one section, second, the heavily travelled roads northeast of Midale reflect the oil activity in that area. These traffic elements are seen to be superimposed on the normal farm to town travel patterns. As with the R.M. of Cambria, note the general absence of traffic across the Souris River, except for #606 and #705 south and west of Halbrite.

.4 R.M. Lomond No. 37

Lomond R.M. is west of Cymri R.M. and has Highway 35 running north - south approximately in the middle of the R.M. Provincial roads provide access to the villages of Colgate and Goodwater from Highway 35. The Souris River, Roughbark

TRAFFIC FLOW MAP

FIGURE 3

R.M. OF CAMBRIA NO. 6

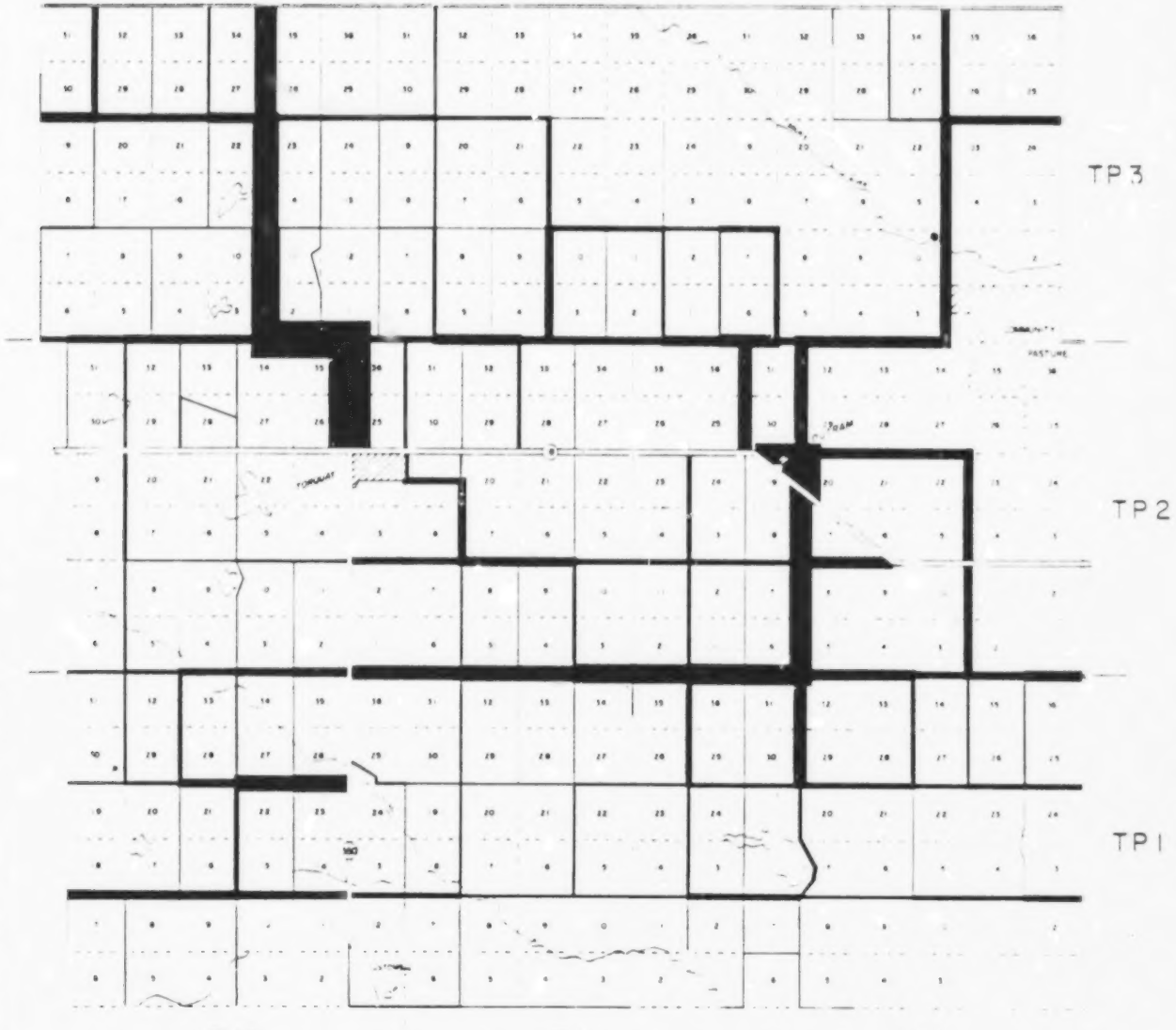
W. OF 2ND

LEGEND

5
25
50
75
100

AVERAGE ANNUAL DAILY TRAFFIC

983



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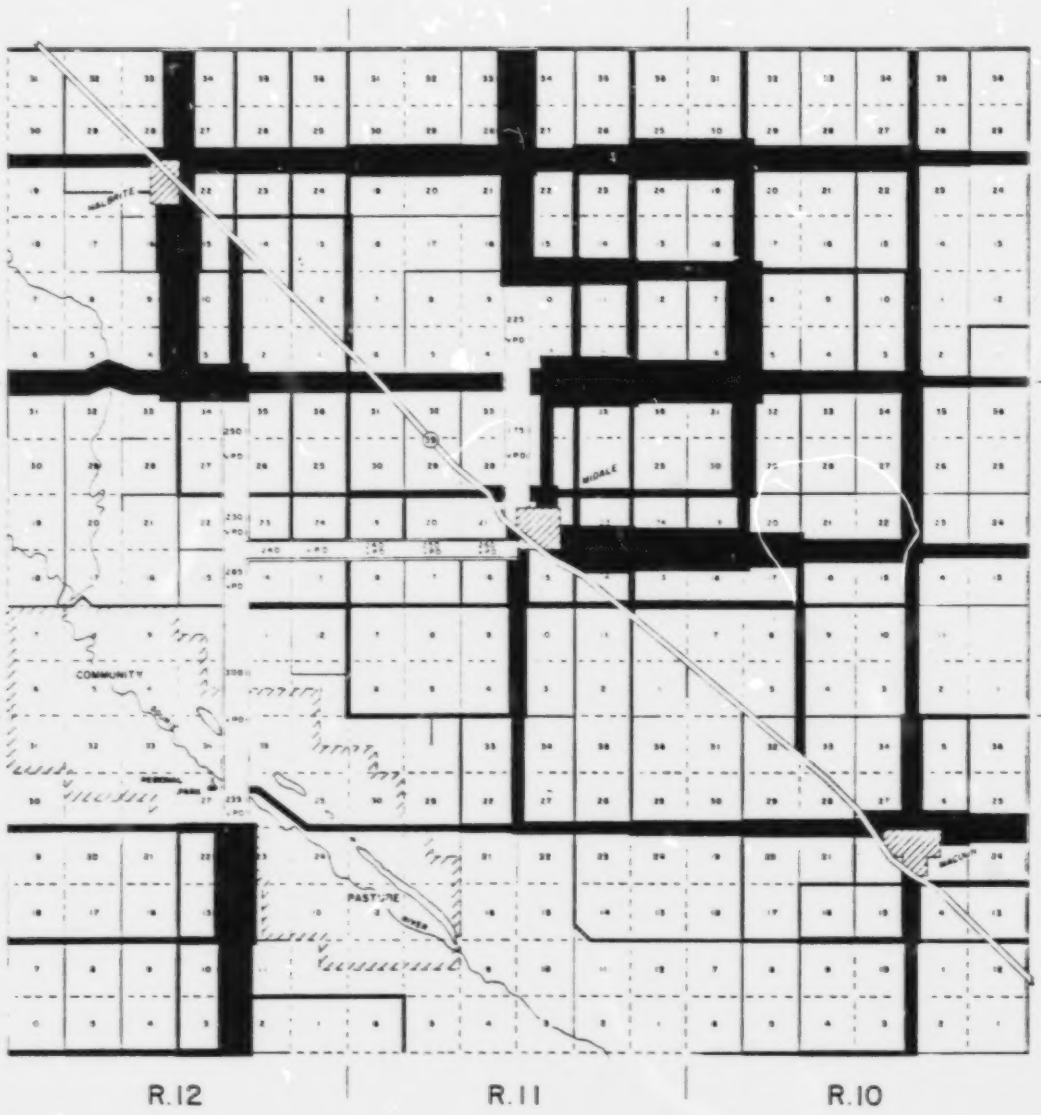
TRAFFIC FLOW MAP

FIGURE 4

R. M. OF CYMRI NO. 36

W. OF 2ND



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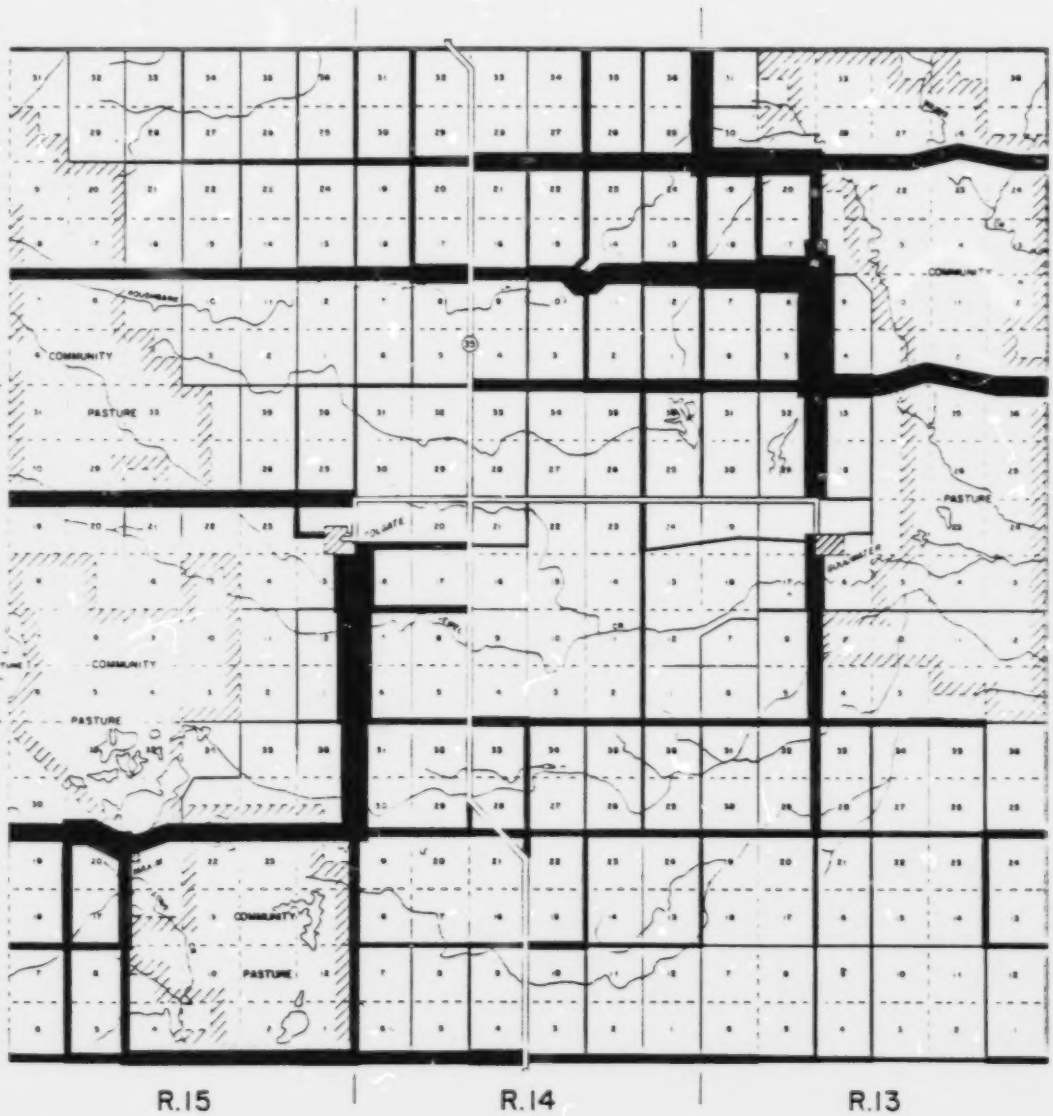
CONSULTING ENGINEERS

TRAFFIC FLOW MAP

FIGURE 5

R.M. OF LOMOND NO. 37

W. OF 2ND



and Jewel Creeks are found in the northern and eastern part of the R.M. where Lomond P.F.R.A. Community Pasture is located. Other community pasture lands occupy much of the R.M. west of Colgate.

The heavier traffic flows north of Goodwater are attributed to the oil industry; there are a number of oil wells, storage tanks and a plant located there. Access across the Souris River to the east (Halbrite) is afforded by two grid roads - the north has a volume of 60 vehicles per day; the south (#705) has a volume of 75 vehicles per day. This latter grid road was regraded and straightened in 1986 where it crosses Roughbark Creek.

The more heavily travelled roads in the southwest reflect local traffic to Colgate which is channeled by a limited number of routes through the community pastures.

.5 R.M. Weyburn No. 67

With the City of Weyburn in its center, the traffic pattern in this R.M. displays a fairly well-developed rural network. The heirarchy of rural roads is also well-defined even with the six highway routes leading in/out of the city. The Souris River cuts diagonally across the R.M. from northwest to southeast, through the city. Creation and operation of the Rafferty Reservoir will not directly influence land uses or traffic patterns in the R.M.

ALAMEDA RESERVOIR AREA

.1 R.M. Moose Creek No. 33

The Rural Municipality of Moose Creek has Alameda located on it's southern border with Highway 9 running from Alameda north towards Carlyle. Traffic flows in the R.M. are modest with concentrations near Alameda and north of Oxbow. North/south traffic in the R.M. is principally local in nature. Five roads, including Highway 361 grid, cross Moose Mountain Creek east/west. Four of these roads will be affected by the proposed Alameda Reservoir.

.2 R.M. Moose Mountain No. 63

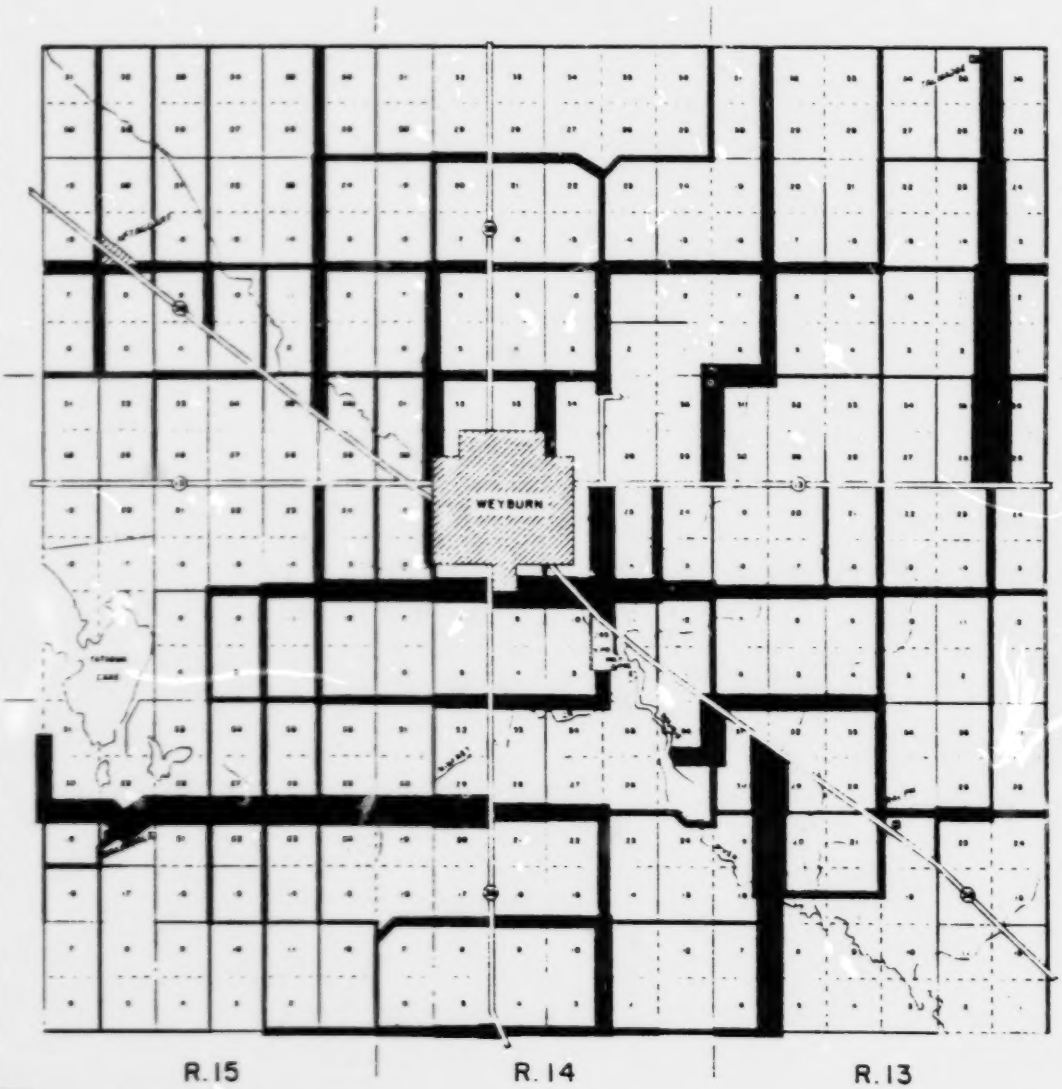
This R.M. has the urban municipalities of Carlyle and Manor within its boundaries. It is bisected by Highway 9 running north/south and Highway 13 running east/west. Part of the Moose Mountain Provincial Park and the White

TRAFFIC FLOW MAP

FIGURE 6

R.M. OF WEYBURN NO. 67

W OF 2ND



TRAFFIC FLOW MAP

FIGURE 7

R. M. OF MOOSE CREEK NO. 33

W. OF 2ND

LEGEND

5
25
50
75
100

AVERAGE ANNUAL DAILY TRAFFIC
1982

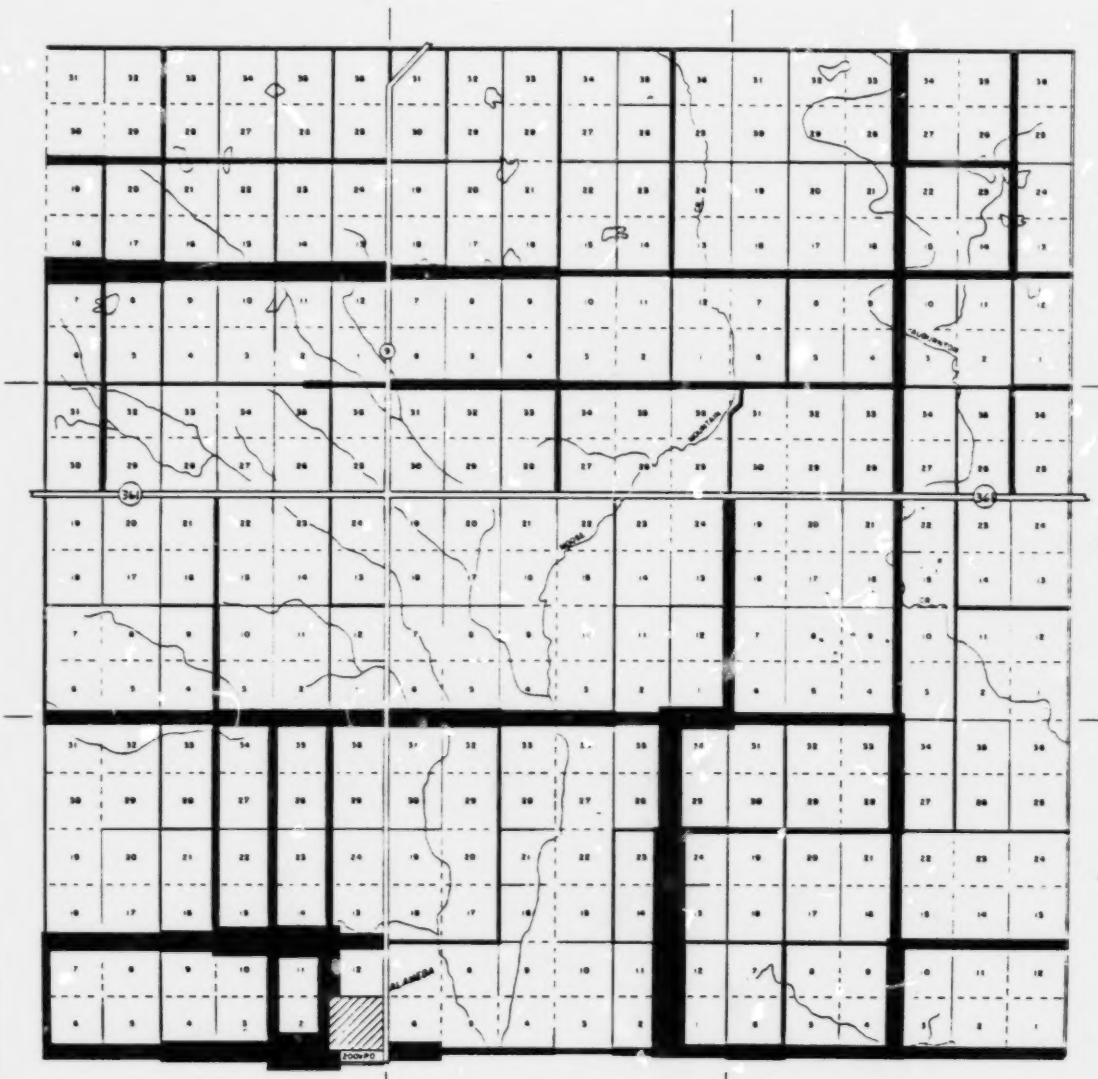


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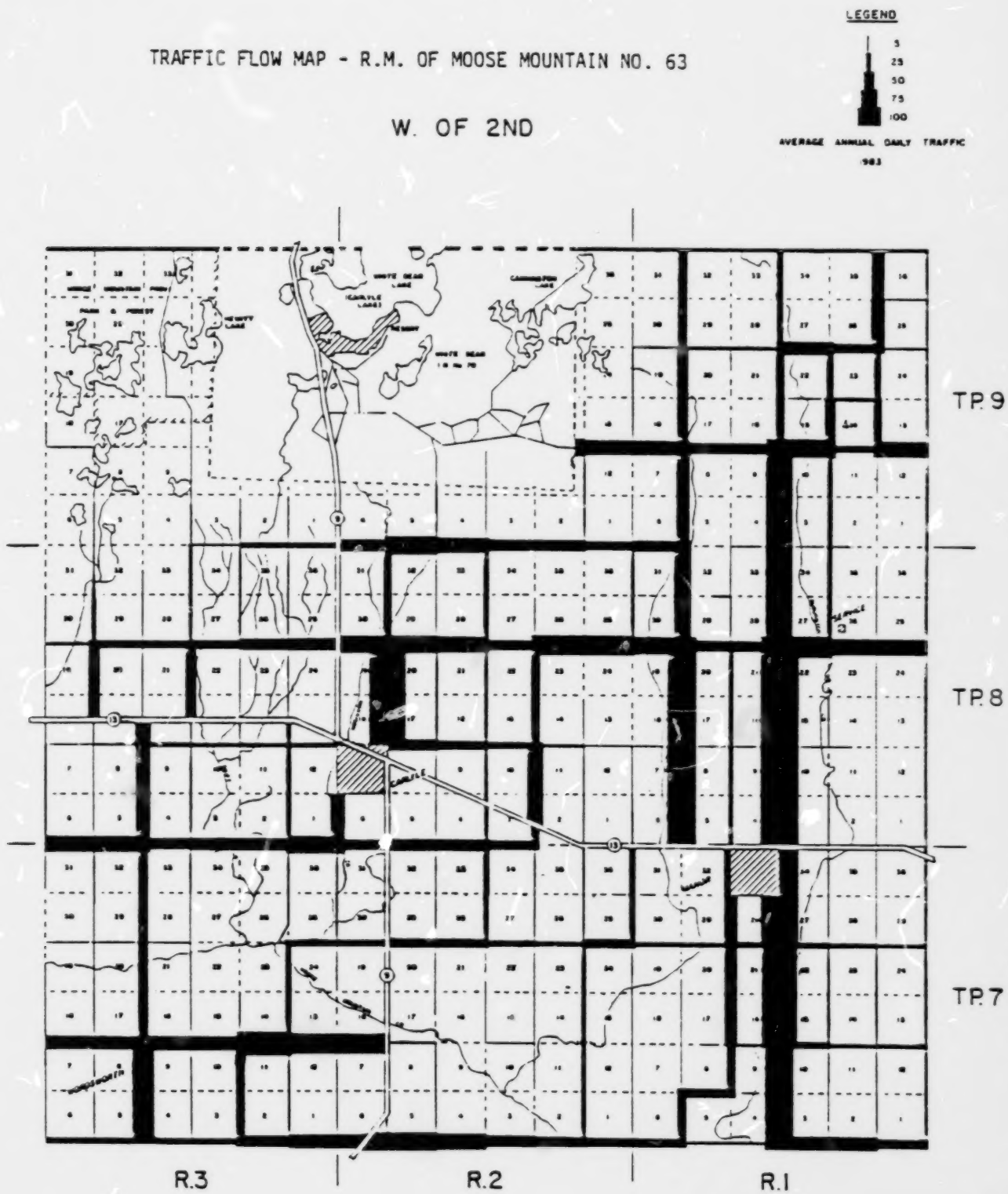
FIGURE 8
ALAMEDA RESERVOIR

TRAFFIC FLOW MAP - R.M. OF MOOSE MOUNTAIN NO. 63

W. OF 2ND



Bear Indian Reserve are located in the northern part of the R.M. The major rural traffic route runs north and south past Manor on Primary Grid 603. Generally, the highest level of traffic is found in the area south and east of the Indian Reserve. Only the east/west road along the southern boundary of the R.M. will be directly influenced by the proposed Alameda Reservoir. Average annual traffic flows on that road in the vicinity of Moose Mountain Creek are in the order of 40 vehicles per day.

IMPACT OF PROPOSED RAFFERTY AND ALAMEDA RESERVOIRS

INTRODUCTION

The reservoirs at Rafferty and Alameda will inundate several existing roadways and bridges. Some of these roadways are Primary Grids with average daily traffic volumes up to 300 vehicles as at #606 adjacent to the Dr. Mainprize Regional Park. Other roadways are of lesser significance providing access primarily for local agricultural activities. Without mitigation of these inundated roadways, hardship would be encountered by residents of the municipalities as well as through-traffic. Figures 9 and 10 indicate the location of existing crossings and roads which would be affected by the reservoirs. They include the following:

EXISTING ROADWAYS AFFECTED BY THE PROPOSED RESERVOIRS

		Approximate Land Location (W 2M)
A)	Rafferty Reservoir Roads	
1)	Existing farm access road immediately downstream of Rafferty Dam adjacent to CPR trestle	SE 1/4 25-T2-R8 (RM Estevan)
2)	North-South Macoun to Outram crossing, 13 km South of Macoun	Between sections 10 and 11-T3-R9 (RM of Cambria)
3)	East-West roadway Macoun to #606 Primary Grid across Dead Lake Channel and along north side of Souris River Valley to Dr. Mainprize Park (16 to 20 km west of Macoun)	Between sections 24 and 25 and in section 26 T4-R12 (RM of Cymri)

WEYBURN
N

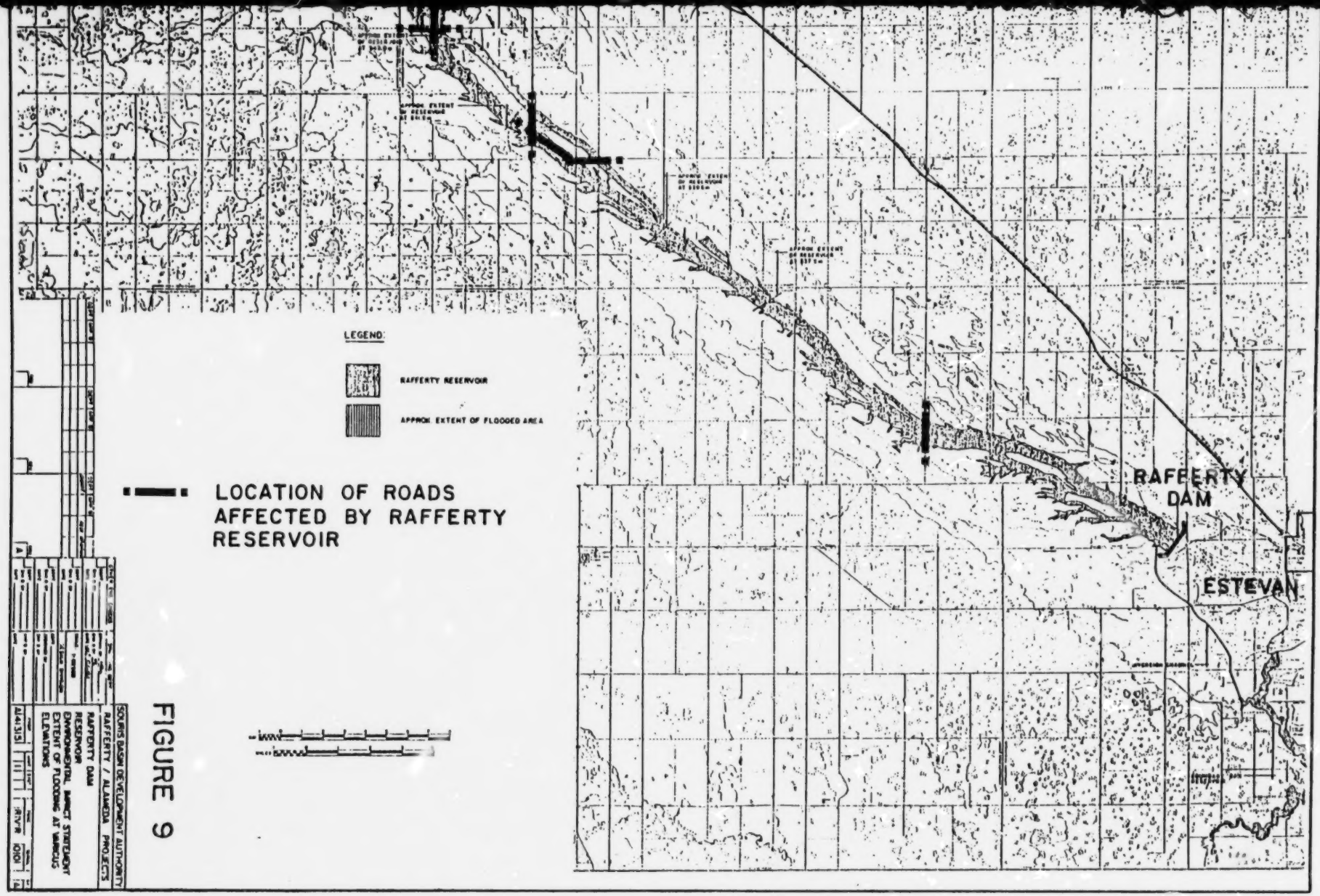
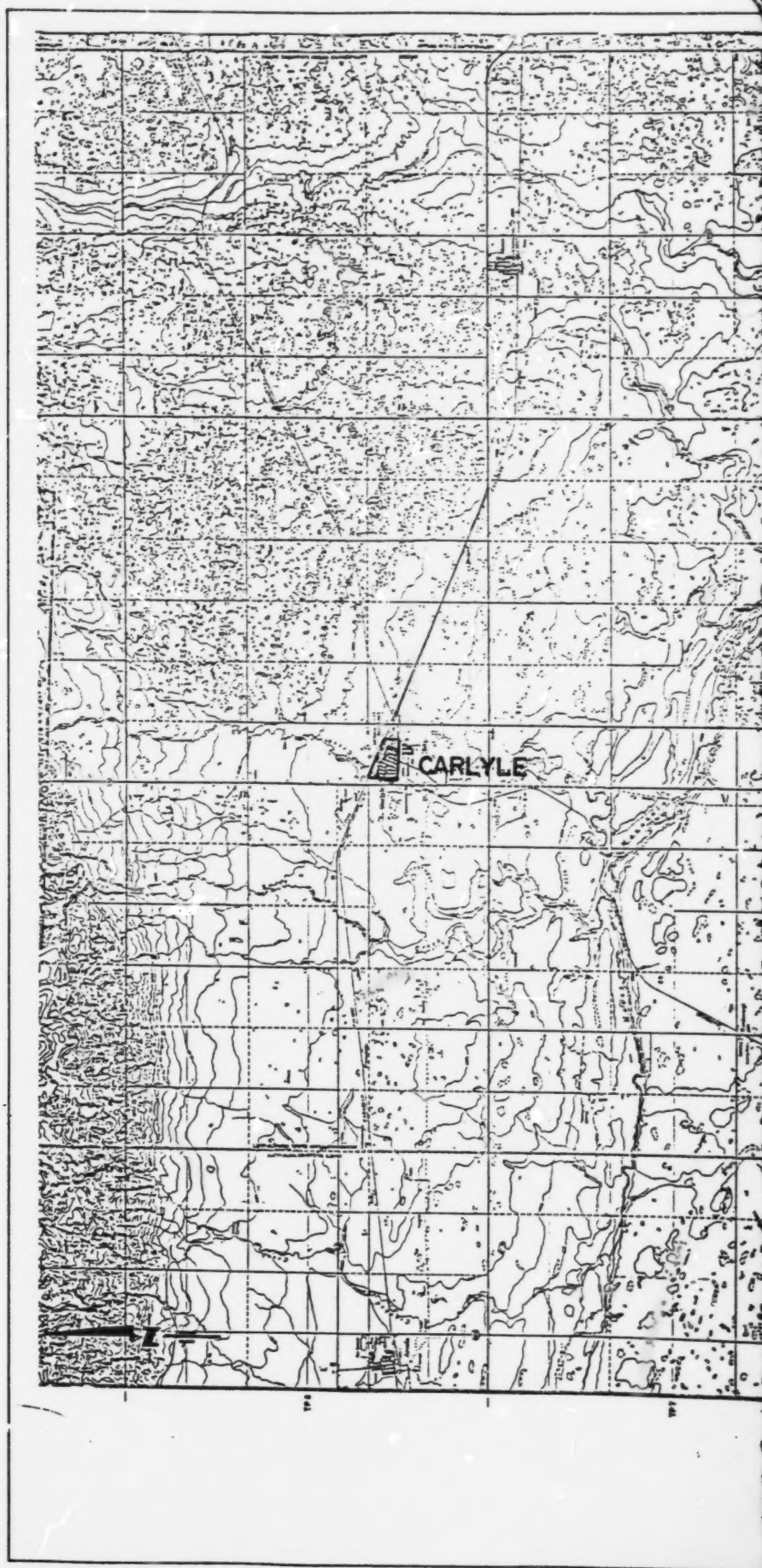

LEGEND:
RAFFERTY RESERVOIR
APPROX EXTENT OF FLOODED AREA
LOCATION OF ROADS AFFECTED BY RAFFERTY RESERVOIR
RAFFERTY DAM
ESTEVAN
SOURIS BASIN DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS
RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
EXTENT OF FLOODING AT VARIOUS ELEVATIONS

FIGURE 9


CARLYLE

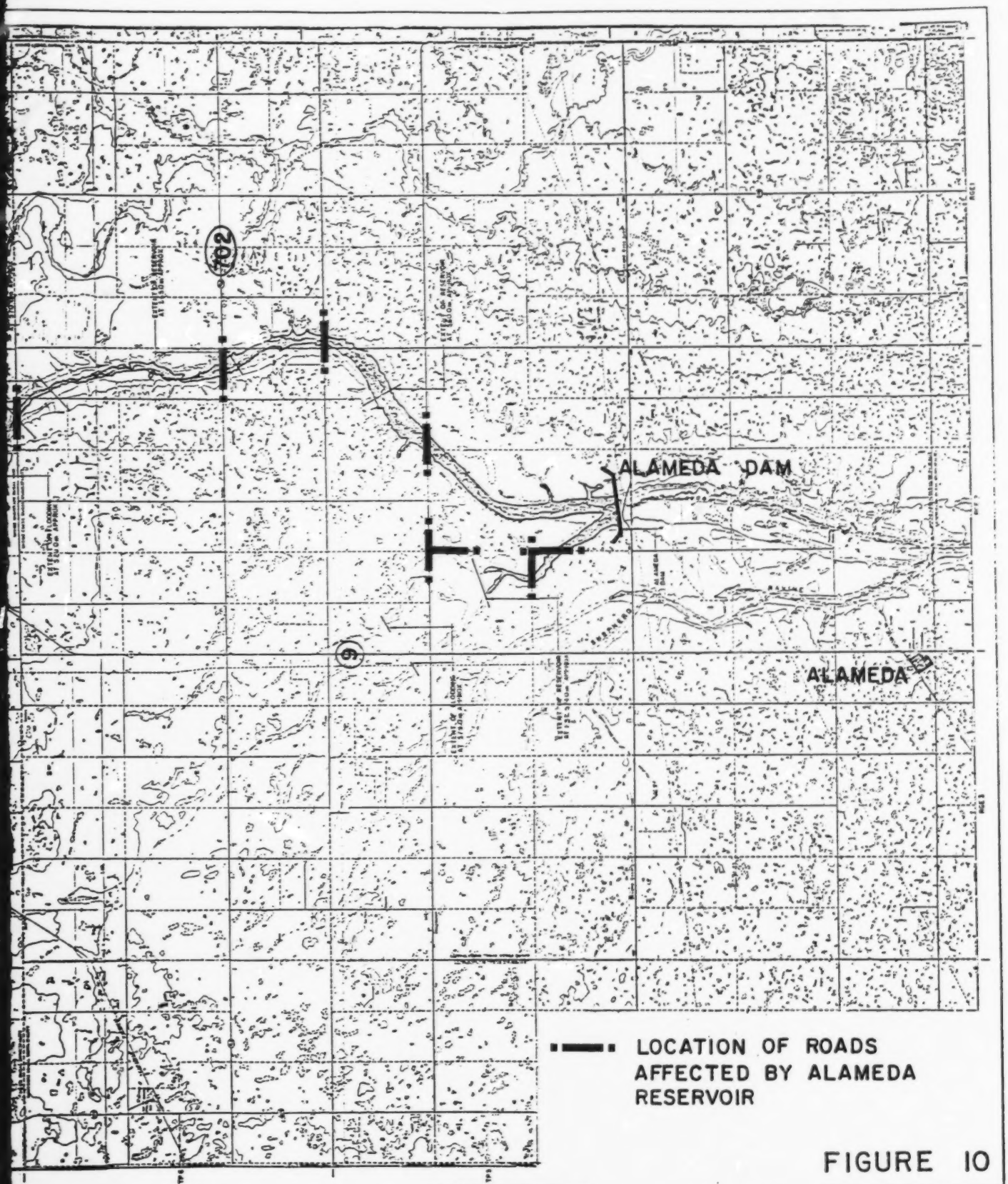


FIGURE 10

SOUTH BAY DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS
ALAMEDA DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
EXTENT OF FLOODING AT
VARIOUS RESERVOIR ELEVATIONS

4)	North-South Primary Grid #606 across Dead Lake Channel and Souris River Valley	Between sections 34 35 and sections 26 and 27, T4-R12 (RM of Cymri)
5)	East-West farm access along north boundary of Midale SDA Community Pasture	Between sections 8 and 17, T5-R12 (RM of Cymri)
6)	North-South farm access road across Roughbark Creek 6 km south of Primary Grid #705	Between sections 17 and 18 T5-R12 (RM of Cymri)
7)	East-West Primary Grid #705 across Souris River Valley 8 km west of Highway 39	Between sections 32-Twp 5-R12 and Section 5 Twp 6-R12 (RM of Cymri)
8)	East-West Primary Grid #705 across Roughbark Creek 4 km north and 3 km east of Goodwater	Between Section 34-T5-R13 and section 3, T6 - R13 (RM of Lomond)
9)	East-West Grid across Souris River 8 km west of Halbrite	In Section 26-T6-R13 (RM of Lomond)
B)	<u>Alameda Reservoir</u>	Approximate <u>Land Location (W 2M)</u>
1)	East-West Provincial Highway #361 6.5 km east of Highway #9	Between sections 22,23 and 26-27, T5-R2 (RM Moose Creek
2)	North-South farm access connecting to #361 at 1) above	Between sections 22 23, T5-R2 (RM Moose Creek)
3)	North-South farm access road two miles east of Highway #9 2 km northwest of proposed Dam Site	Between sections 8 9; Twp T5-R2. (RM Moose Creek)
4)	East-West farm access road 3 km northwest of proposed Dam Site	Between Sections 8 17, Twp 5-R2 (RM Moose Creek)
5)	East-West Provincial Highway #361 3 km east of Highway 9	Between Sections 20 and 29, Twp 5-R2 (RM Moose Creek)

6) East-West Main farm access road 4.5 km west of Primary Grid #603	Between Sections 31 Twp 5, R2 and section 6-T6, R2 (RM Moose Creek)
7) North-South farm access 2 km north of #361 connecting with east-west road in 6) above	In Section 31 Twp 5, R2 (RM Moose Creek)
8) East-West Primary Grid #702 5.5 km west of #603	Between sections 12 and 13; T6, R2 (RM Moose Creek)
9) East-West Main Farm Access Road between RM of Moose Creek and RM of Moose Mountain 6.5 km east of Highway #9	Between Section 35 T6, R2 and Section 2 T7, R2 (RM of Moose Mountain)
10) North-South farm access road connecting to east-west main farm access .5 km south of it	Between Sections 35 and 36 T6-R2 (RM Moose Creek)

Although the Alameda Reservoir will be approximately one-half the length of the Rafferty Reservoir, the potential impact on existing roadways will be roughly equivalent, reflecting the more extensive traffic movements across the Moose Mountain Creek in the Rural Municipality of Moose Creek. Farm settlement and cultivation in the Rafferty Project Area have been more restricted along the Souris River Valley due to the extreme stoniness of the adjacent uplands. The extensive grazing lands within the three community pastures in the Rafferty Project Area have made municipal roadways unnecessary in many localities.

The Souris Basin Development Authority recognizes that it would not be economically feasible to elevate roads or construct causeways or bridges at all identified locations. In order to recommend viable mitigation options for each Project Area, the Authority commissioned the Saskatchewan Power Corporation to undertake an engineering assessment and pre-feasibility review of all identifiable options. This assessment included possible causeway locations, cross-sections and costs. Construction design and cost information was obtained from Saskatchewan Highways, Saskatchewan Rural Development, Cochrane Lavalin, Armco Westeel, Robert Allan Ltd. and C.P. Rail. The following mitigation proposals are based upon the Rafferty/Alameda Causeways Phase 1 Engineering Report, May, 1987.

MITIGATION OPTIONS

The Authority recognizes the potential long-term recreational value of placing public access roads across the crests of both the Rafferty and Alameda Dams. Engineering designs for each dam will include sufficient crest width (10 m) to accommodate a Primary Grid standard of roadway. All roadways, bridges, causeways and drainage structures will be built to accepted provincial standards.

The following causeway construction parameters and terms of reference were used as guidelines for the Saskatchewan Power Corporation assessment of mitigation options:

a) causeways would be earth filled;

b) crest heights of causeways would be 0.5 m above the controlled flood levels on each reservoir to ensure public use during full flood control operations of the reservoirs;

c) crest heights for the Dead Lake Channel closure dams would be 1.0 m above controlled flood elevations on Rafferty Reservoir;

d) slopes exposed to wave action would be rock rip-rapped;

e) varying cross-sections and slopes would be evaluated;

f) roadway surfacing would be similar to connecting roads;

g) profiles would follow Primary Grid road standards;

h) crest widths on all causeways would be 10 m;

i) guard rails would be evaluated;

j) bridges versus culverts would be assessed for major causeway locations;

k) ferry construction and annual operating costs would be assessed for locations where causeways were economically not feasible;

l) alternative alignments or locations of causeways would be assessed where viable options were apparent;

m) gated control structures would be evaluated on causeways in the upper reaches of the reservoirs to create stable wetlands for wildlife, waterfowl and fish spawning or rearing; and

n) all railway relocation profiles and cross-sections would be to Canadian Pacific Railway standards.

Variations of 39 different options were evaluated for the Rafferty Project Area and 24 others for the Alameda Project Area. Cost estimates were prepared for each option in order to identify the most economical options. Tables 2 and 3 summarize the costs of the evaluated options. Appendix 1 provides details of the methodology, design parameters and unit costs.

RECOMMENDED ROADWAY MITIGATION

As illustrated in Figures 11 and 12, the Souris Basin Development Authority will undertake the following mitigation measures to reduce the negative effects of the reservoirs on local and regional transportation routes:

A. Rafferty Project Area:

R1: Dam Site Access Roads from Highway 39 and Highway 18 (11 km)

A new truck route to the project construction site for supplies, equipment and construction workers will be required immediately. The truck route would avoid built-up residential areas in Estevan and it would concentrate such traffic on one route for ease of maintenance and special permit control (restricted access). The truck route from #39 Highway to the north would separate heavy traffic from other light/public traffic for safety and efficiency. The truck route will serve as a long-term recreational and Estevan-Cambria PFRA Community Pasture access route from the north. During construction of the Rafferty Dam, these roads will have gravel surfaces. After completion of the dam, they will be paved.

The approved truck route will be identified through appropriate signs, and written into any material supply/haul contracts. The existing Rural Municipality road west of the Westview subdivision in Estevan, and north of sections 19 and 20 (Township 2, Range 8, W 2nd M) may be terminated at the CPR railway crossing to eliminate that possible "shortcut" between Estevan and the dam site. The existing farm access road between the dam and the CPR trestle will be eliminated following completion of the downstream outlet channel and the service spillway channel.

A public access/visitor and construction viewing point access from Highway #18 from the south will effectively and safely segregate public traffic from the

Table No. 2
Rafferty Roads and Causeways
Costs of Evaluated Options

Rafferty Roads and Causeways	Description	Bermed Section	3:1 Section	6:1 Section	Other
R1	Paved Road - from Hwy. 18 & Hwy. 39 to Rafferty Dam	n/a	n/a	n/a	Road Cost* $1 466 000*
RR	C.P. Railway Relocation	Surplus Excavated Material Wasted			$ 827 000
RR	C.P. Railway Relocation	Surplus Excavated Material Used in Dam			$ 571 000*
R2	Ferry Crossing - South of Macoun	Large Ferry Boat (36 x 14)			$1 250 000
R2	Ferry Crossing - South of Macoun	Small Ferry Boat (23 x 9)			$ 450 000
R3-1	Causeway - Existing Alignment of No. 606 on Souris	$4 093 000	$3 633 000	$6 004 000	n/a
R3-1	Causeway - 1.0 km Upstream of No. 606 on Souris	$2 796 000*	$2 419 000	$3 789 000	n/a
R3-1	Causeway - 1.0 km Upstream of No. 606 on Souris with 300 m Bridge	$4 769 000	$4 474 000	n/a	n/a
R3-2	Causeway - Existing Alignment No. 606 on Dead Lake	$1 544 000	$1 312 000	$2 345 000	n/a
R3-2	Dam - Existing Alignment No. 606 on Dead Lake	$1 722 000	$1 509 000	$2 286 000	n/a
R3-2	Causeway - 0.2 km Upstream of No. 606 on Dead Lake	$1 042 000	$ 882 000	$1 601 000	n/a
R3-2	Dam - 0.2 km Upstream of No. 606 on Dead Lake	$1 149 000*	$1 008 000	$1 452 000	n/a
R3-3	Gravel Road - From No. 606 to Macoun West Grid	n/a	n/a	n/a	Road Cost* $275 000
R4	Dam - Upstream End of Dead Lake Channel	$ 696 000*	$ 654 000	$ 948 000	n/a
R5	Causeway - No. 705 Across Souris	n/a	$ 874 000	n/a	2:1 Slopes* $516 000
R6	Causeway - No. 705 Across Roughbark	n/a	$ 421 000	n/a	2:1 Slopes* $277 000
R7	Halbrite West - Grid Road Across Souris	n/a	n/a	n/a	No Work* Required
R8	N-S Farm Access Across Roughbark Creek	$2 223 000	$1 797 000	n/a	n/a
R9	E-W Farm Access Across Souris River	$4 750 000	$4 077 000	n/a	n/a

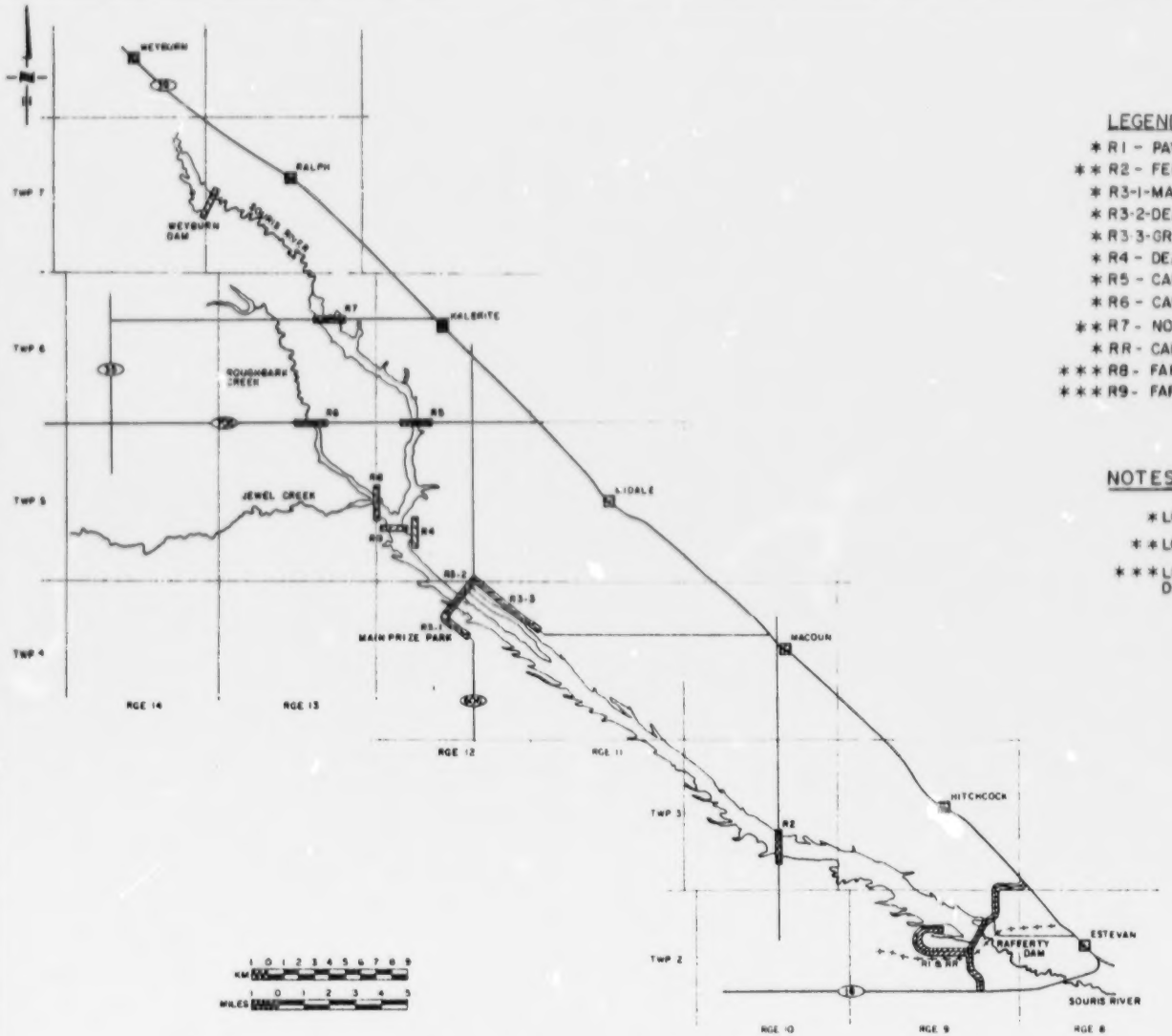
* - Recommended Options

Table No. 3

Alameda Roads and Causeways
Costs of Evaluated Options

Alameda Roads and Causeways	Description	Bermed Section	3:1 Section	6:1 Section	Other
A1	Hwy. No. 361 - Rerouting	n/a	n/a	n/a	Dept. of Hwy. Expense
A2-1	Causeway - No. 702 Existing	$2 815 000	$2 516 000	$4 069 000	n/a
A2-2	Causeway - 0.8 km North of No. 702 Existing	$1 375 000*	$1 261 000	$1 882 000	n/a
A2-3	Causeway-RM Boundary Between Twp. 6 and Twp. 7	$1 957 000	$1 727 000	$2 741 000	n/a
A2-4	Gravel Road-Farm Access From RM Boundary	n/a	n/a	n/a	$ 88 000*
A3-1	Causeway - West Arm and Hwy. 361	n/a	$ 892 000*	$1 604 000	n/a
A3-2	Gravel Road-Farm Access From Hwy. 361 & West Arm	n/a	n/a	n/a	$ 193 500*
A3-3	Gravel Road-Farm Access From Hwy. 361 East of Reservoir	n/a	n/a	n/a	$ 88 000*
A3-4	Gravel Road-Farm Access From Twp. 5 & 6 Boundary	n/a	n/a	n/a	$ 110 000*
A3-5	West Arm - E/W Road	$3 078 000	$2 554 000	n/a	n/a
A3-6	West Arm - N/S Road	$4 447 000	$3 715 000	n/a	n/a
A3-7	Causeway-Across Moose Mountain Creek along Twp. 5 & 6 Boundary	$4 124 000	$3 564 000	$5 895 000	n/a

* - Recommended Options



LEGEND

- * R1 - PAVED ROAD CONNECTING HWY 39 & HWY. 18 TO DAM SITE "C."
- * * R2 - FERRY CROSSING SOUTH OF MACOUN.
- * R3-1-MAINPRIZE CAUSEWAY AND PAVED ROADS TO HWY 606 & R3-2.
- * R3-2-DEAD LAKE CHANNEL DOWN STREAM DAM.
- * R3-3-GRAVEL ROAD FROM R3-2 TO MACOUN WEST GRID
- * R4 - DEAD LAKE UPSTREAM DAM.
- * R5 - CAUSEWAY ON SOURIS AND HWY 705 INTERSECTION.
- * R6 - CAUSEWAY ON ROUGHBARK AND HWY 705 INTERSECTION.
- * * R7 - NO WORK REQUIRED TO EXISTING GRAVEL ROAD OR BRIDGE.
- * RR - CANADIAN PACIFIC RAILWAY RELOCATION
- * * * R8 - FARM ACCESS ACROSS ROUGHBARK CREEK
- * * * R9 - FARM ACCESS ACROSS SOURIS VALLEY

NOTES

- * LOCATIONS RECOMMENDED FOR CONSTRUCTION
- * * LOCATIONS NOT RECOMMENDED FOR CONSTRUCTION
- * * * LOCATIONS NOT RECOMMENDED & NO DETAILED DRAWINGS DRAFTED

FIGURE II

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY AND ROAD
LOCATIONS EVALUATED

DEPT	APP'D	DEPT	APP'D	DEPT	APP'D	DEPT	APP'D	DEPT	APP'D
REV		REV		REV		REV		REV	A

OTHER ENG. CHECKS: DEPT / CHK'D BY / DATE

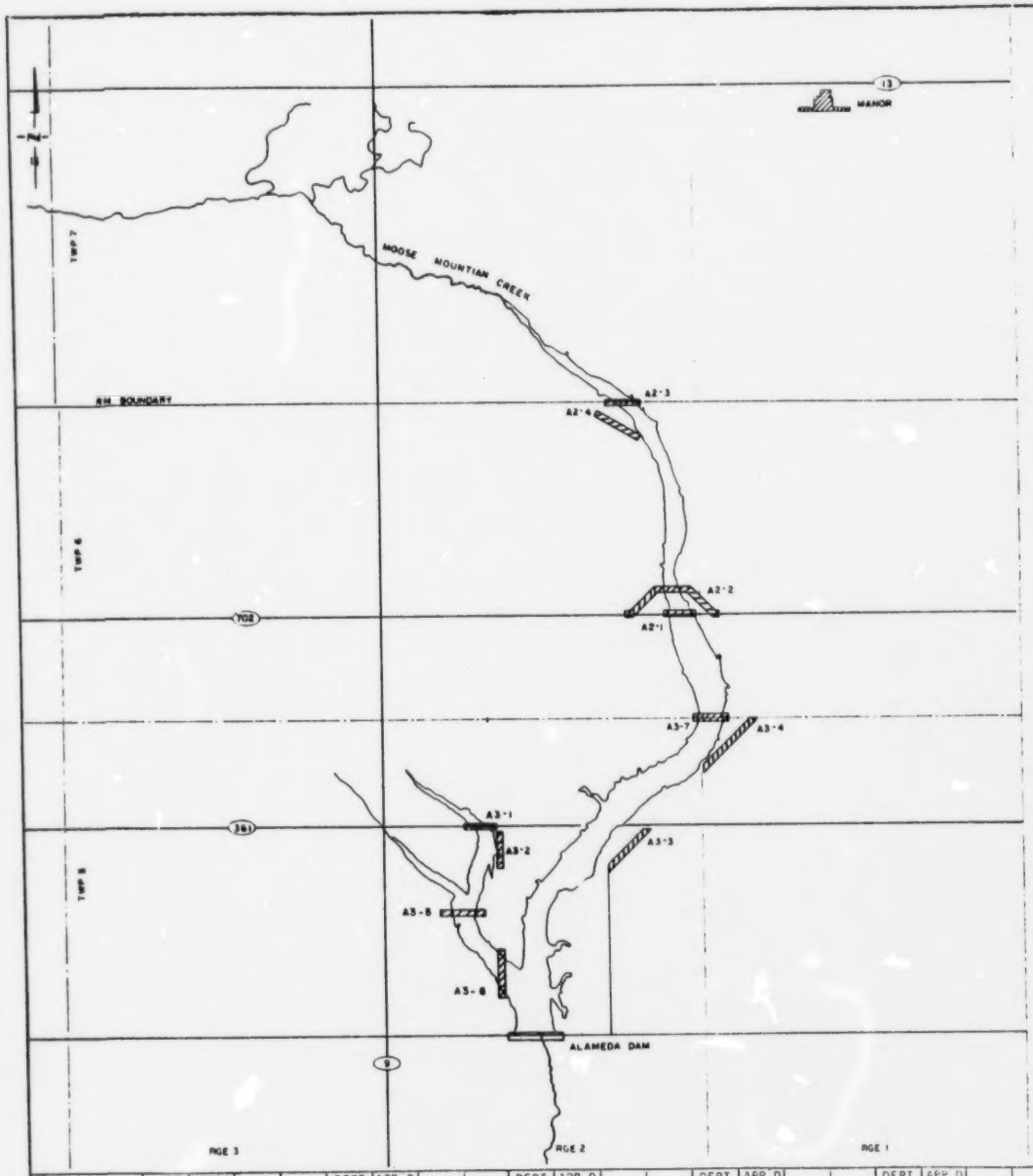
DRAFTING DEPT: DRAWN BY / CHK'D BY / DATE

SCALE

DESIGN DIVISION: DEPT / DESIGNED BY / CHK'D BY

APP'D BY / DATE

PROP	UNIT	SYST	FUNC	SERIAL	REV
A435	140		RVR	002	A



LEGEND

- * A1 - REROUTING OF HWY. 361 BY SASK. HWYS.
- * * A2-1 - CAUSEWAY AT EXISTING HWY. 702.
- * A2-2 - CAUSEWAY 0.8 km NORTH OF EXISTING HWY. 702 AND CONNECTING GRAVEL ROADS.
- * * A2-3 - CAUSEWAY AT RM BOUNDARIES.
- * A2-4 - GRAVEL ROAD FOR FARM ACCESS.
- * A3-1 - CAUSEWAY AT WEST ARM & EXISTING HWY. 361.
- * A3-2 - GRAVEL ROAD FOR FARM ACCESS.
- * A3-3 - GRAVEL ROAD FOR FARM ACCESS.
- * A3-4 - GRAVEL ROAD FOR FARM ACCESS.
- * * * A3-5 - FARM ACCESS E/W WEST ARM
- * * * A3-6 - FARM ACCESS N/S WEST ARM

NOTES

* LOCATIONS RECOMMENDED FOR CONSTRUCTION

* * LOCATIONS NOT RECOMMENDED FOR CONSTRUCTION

* * * LOCATIONS NOT RECOMMENDED FOR CONSTRUCTION & NO DETAILED DRAWINGS DRAFTED

KM 1 0 1 2 3 4 5 6 7 8 9

MILES 1 0 1 2 3 4 5

FIGURE 12

DEPT	APP'D	DEPT	APP'D	DEPT	APP'D	DEPT	APP'D	DEPT	APP'D	DRAFT	SNR

REV. REV. REV. REV.

OTHER ENG CHECKS	DRAFTING DEPT.
DEPT	DRAWN BY GMM
CHK'D BY	CHK'D BY
DATE	DATE
DEPT	SCALE
CHK'D BY	
DATE	DESIGN DIVISION
DEPT	DEPT
CHK'D BY	DESIGNED BY
DATE	CHK'D BY
DEPT	APP'D BY
CHK'D BY	DATE
DATE	

REV. A

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

ALAMEDA DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY & ROAD
LOCATIONS EVALUATED

PROJ	UNIT	SHT	FUNC	SERIAL	REV
A436	1140		RVR	001	A

main construction traffic. With the main borrow areas, service spillway and emergency spillway north of the dam site, the public will be excluded from that area.

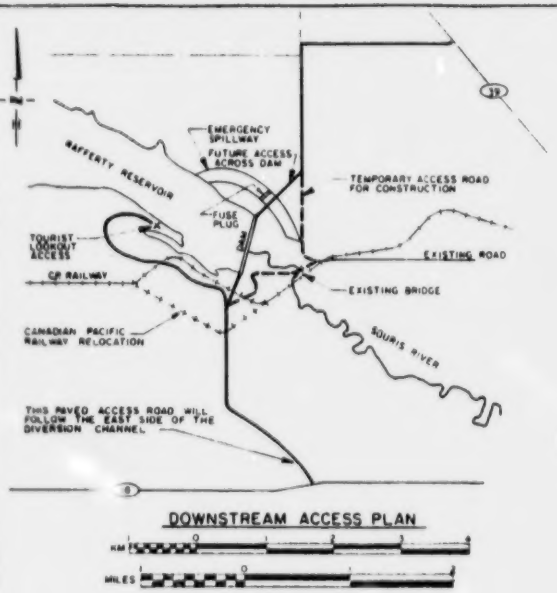
The public access road from Highway 18 will become the permanent recreational access route from the south, following the eastern side of the Boundary to Rafferty diversion channel. This road will be designed for subsequent connection to the northern access road across the top of the dam. This will provide full public access to the dam, offering an excellent view of the reservoir and adjacent park lands to the west. Figure 13 illustrates the proposed northern and southern access roads to the Rafferty Dam Site. The total cost of this access road is estimated to be $1,466,000.

Aggregate resources in Section 27, Township 2, Range 9, intended for various uses in the dam construction, will have to be hauled over an approved route (on the floor of the valley below Full Supply Level) to ensure that heavy construction equipment and trucks do not have a negative impact on the uplands south of the reservoir, intended for future park land uses.

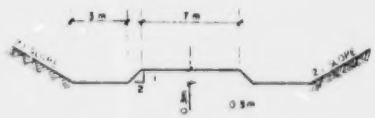
Stones and boulders to serve as rip-rap wave protection on the dam will be harvested from selected upland areas which will be subsequently utilized for day use recreation, camping areas and cottage subdivisions. Alluvial topsoil from the base of the dam will be stripped and placed within these recreational areas to provide an excellent base for landscaping with lawns, trees and shrubs. Haul routes to and from the dam site for these materials will be designated on the ground to restrict equipment and trucks to future park access routes and internal park roadways. This will ensure that the natural landscape is not unnecessarily disturbed.

RR: Canadian Pacific Railway Relocation

As part of the dam construction, the Authority will relocate approximately 2.5 km of existing railway trackage. In its present location, extensive rip-rap protection would be required to prevent erosion of the railway grade by wave action on the reservoir at or above Full Supply Level. Further, in its present location, two roadways to the park would cross the railway track and the diversion channel would pass under the track and roadway in two other locations. Relocation of the trackage will permit rail and vehicle access across the



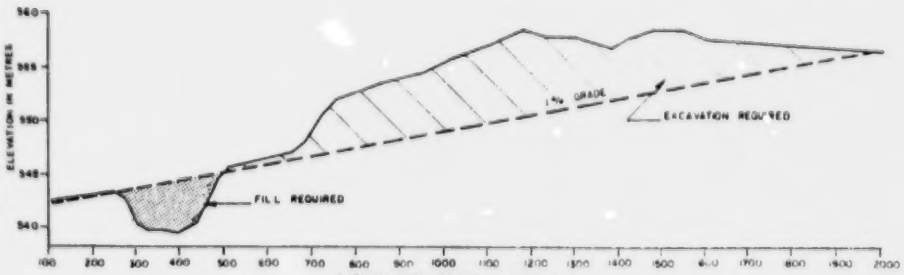
DOWNSTREAM ACCESS PLAN



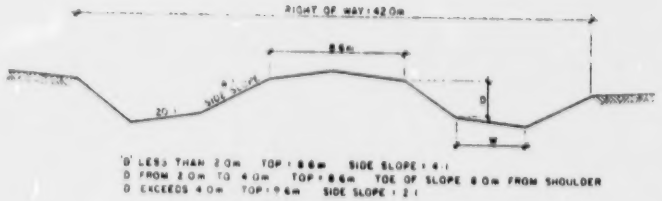
TYPICAL RAIL SECTION
NTS

NOTES:

1. TEMPORARY CONSTRUCTION ACCESS WILL BE FROM HWY 39 FOLLOWING EXISTING ROAD ALLOWANCES TO THE INTERSECTION OF THE C.P.R. RAIL LINE AND THE SOURIS VALLEY APPROXIMATELY 1 km DOWNSTREAM OF RAFFERTY DAM.
2. FUTURE ACCESS WILL BE FROM HWY 39 FOLLOWING ROAD ALLOWANCES, ACROSS THE BYPASS CHANNEL IMMEDIATELY DOWNSTREAM OF THE FUSE PLUG, ACROSS THE DAM AND THEN FOLLOWING THE EAST SIDE OF THE DIVERSION CANAL TO HWY 18.
3. THE TOURIST LOOKOUT ACCESS WILL REQUIRE A STRUCTURE TO CROSS THE DIVERSION CANAL.
4. THE C.P. RAIL RELOCATION IS SHOWN ALSO.



C.P. RAIL RELOCATION PROFILE



TYPICAL ACCESS ROAD SECTION
NTS

FIGURE 13

DEPT	APP'D	DEPT	APP'D	DEPT	APP'D

diversion channel in one location only. This will also allow improved public access to the reservoir within the park immediately upstream from the Dam.

Relocation of the railway trackage was estimated at $420,000 (CPR Pers. Comm. 1987) excluding grading (150,000 m^3 excavation). It has been assumed that any excess excavated railroad grade material is usable in the Rafferty Dam fill. If the excavated material for the railway grade has to be wasted, the additional relocation earthworks cost would be borne entirely by the rail relocation. Figure 13 illustrates the proposed railway relocation. $571,000 has been estimated as the cost for this work (SPC 1987).

R2: Macoun South Grid

The existing Grid Road south of Macoun will be inundated immediately by the Rafferty Reservoir. The average daily traffic is only 40 vehicles per day, primarily related to the PFRA community pasture. Located at one of the deepest and widest sections of the Souris Valley, a causeway at this location was deemed to be unwarranted and not economically feasible. Access across the Dam Site and relocation of the community pasture corrals from the west to the east side of the pasture would reduce the affect of the loss of this roadway to pasture patrons.

As an alternative, the Authority requested Saskatchewan Power Corporation to investigate the feasibility of providing a summer season ferry crossing. Such a crossing would consist of a ferry boat (10 m wide) concrete landings, power, lighting and maintenance storage shed. Two options evaluated the size of the ferry boat. The smaller (6 vehicle) ferry was estimated at $450,000 and the larger ferry (18 vehicle) was estimated at $1,250,000. The Authority is not proposing the inclusion of a ferry crossing in the mitigation program. A ferry may be warranted at some point in the future, depending upon long-term land use and settlement pattern changes.

R3-1 - Primary Grid #606 at Souris River

As the major north-south crossing of the Souris River Valley between Weyburn and Estevan, this crossing was considered by the Authority to be essential. Eight options were evaluated involving two locations, three cross-section designs and three bridge lengths. All options included earth fill, stripping of topsoil, rock rip-rap of surfaces exposed to wave action, roadway

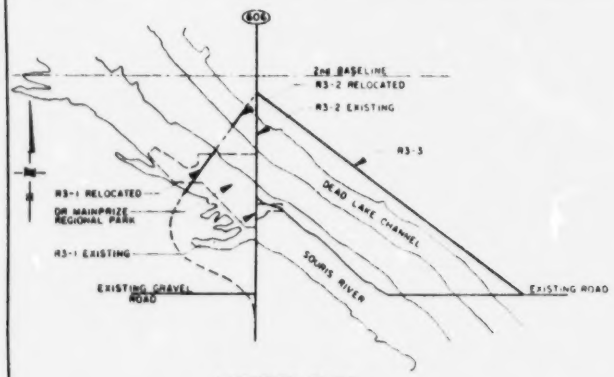
guard rails, connecting roadways with paved surfaces. The crest elevation of the causeway will be .5 m above the Maximum Flood Elevation.

The recommended R3-1 causeway option is the perpendicular alignment located 1.0 km upstream of the existing #606 valley crossing at Dr. Mainprize Regional Park (Figure 14). A bermed cross-section and a 76 m long bridge are proposed. This location was recommended based on least cost. The bermed cross-section was required due to the 13 m depth of fill. The top 6 m of fill would have 3:1 side slopes but the fill below that would have a 6:1 equivalent berm to provide foundation stability. The bridge length was calculated assuming 3:1 abutment slopes in the deepest part of the fill in the Souris River channel. This would permit boat passage at varying reservoir elevations.

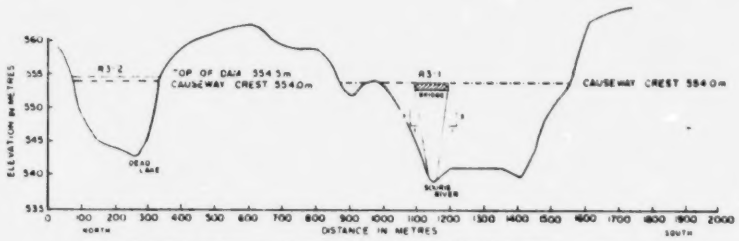
The estimated cost of the recommended option, including bermed and rip-rapped causeway, bridge and paved connecting roads is $2,796,000.

R3-2 - Primary Grid #606 across Dead Lake Channel

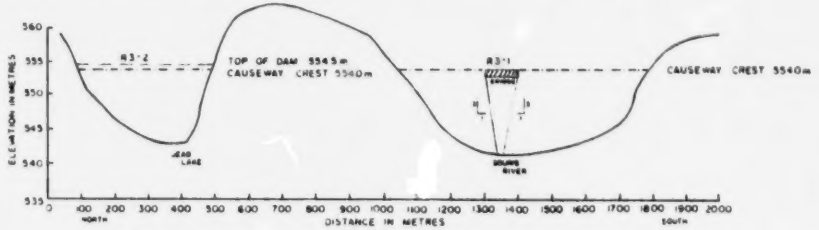
As a continuation of the relocated Souris River crossing across the Dead Lake Channel, this causeway was evaluated considering twelve options. These included two locations, the existing alignment and an alignment perpendicular to the channel, three possible cross-sections for each, and a causeway or a closure dam at each location. The perpendicular location was less costly than the existing alignment and the bermed cross-section was required due to the depth of the fill. It was estimated that a bermed cross-section closure dam at this location would cost approximately $107,000 more than a causeway. In order to preserve approximately 5 km of critical wildlife habitat in the Dead Lake Channel and provide an alternative site for the Dr. Mainprize Regional Park, the Authority will construct a dam at this location rather than the causeway. The dam would be constructed with a crest elevation 1 m higher than the Maximum Flood Elevation of Rafferty Reservoir to provide freeboard. The upstream face of the dam would be grassed while the water-exposed downstream face would be rock rip-rapped as erosion protection. The estimated cost of the bermed cross-section dam is $1,149,000. This includes a paved surface on the relocated #606 Primary Grid (Figure 15).



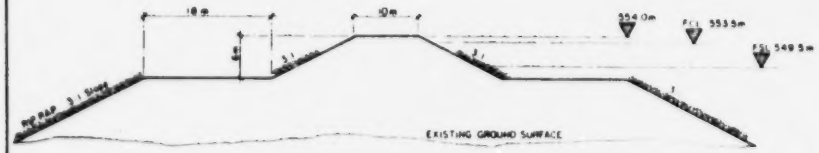
LOCATION PLAN



CENTERLINE PROFILE AT UPSTREAM LOCATION OF R3-1 & R3-2



CENTERLINE PROFILE AT EXISTING LOCATION OF R3-1 & R3-2



TYPICAL CAUSEWAY SECTION
(SEE R-4 FOR TYPICAL DAM SECTION)
N T S

FIGURE 14

NOTE THIS DRAWING INCLUDES R3-1, R3-2 & R3-3

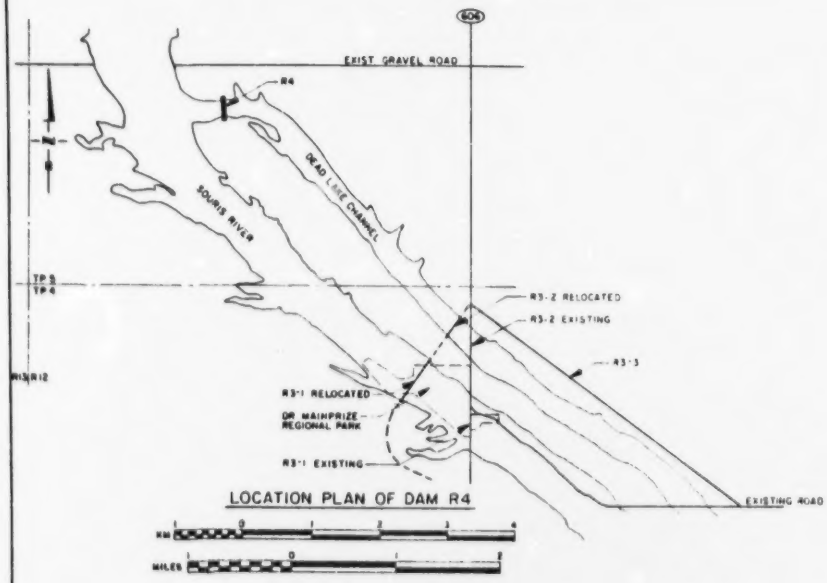
SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

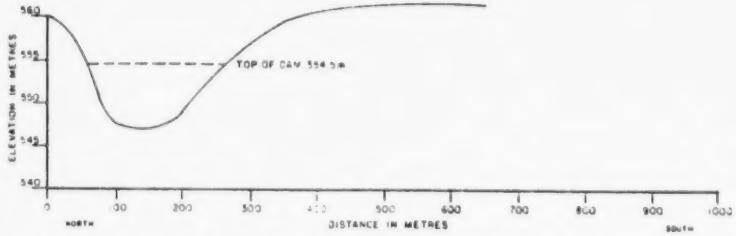
RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY R3's

PROP	UNIT	SYST	FUNC	SERIAL	REV
A435	1140		RVR	005	A

DEPT	APP'D	REV
		A



LOCATION PLAN OF DAM R4



CENTRE LINE PROFILE AT R4

TYPICAL DAM SECTION
NTS

FIGURE 15

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CLOSURE DAM R4

A435 | 1140 | RVR | 006 | A

R3-3 - East-West Grid Road, Macoun to #606

This existing east-west roadway will be inundated by water in the reservoir in both the Dead Lake Channel and the Souris River Valley (Figure 15). Approximately 5 km of new gravel road will be constructed to Grid Road standards along the northern shore of the reservoir adjacent to the Dead Lake Channel. This will retain the east-west road linkage along the north central portion of the reservoir. The cost of this work is estimated at $275,000.

R4 - Western Closure Dam, Dead Lake Channel

In conjunction with the eastern closure dam at #606 across the Dead Lake Channel, this dam will prevent the Rafferty reservoir from inundating 5 km of the Dead Lake Channel. This portion of the channel provides opportunities to relocate the Dr. Mainprize Regional Park into a sheltered environment similar to its present location. It also protects critical wildlife habitat and provides opportunities to replace some of the wetlands which will be inundated in the Souris Valley near the Midale Dam.

The recommended dam structure involved a bermed cross-section due to the depth of the fill. The crest of the dam will be one metre above the Maximum Flood Elevation. As with the eastern closure dam (R3-2), the reservoir face of the dam will be rip-rapped and the downstream face will be grassed and landscaped. A small pump with necessary piping will be included in the structure to permit release of the Rafferty water downstream into the Dead Lake Channel for maintaining water in the small wetlands.

The total cost of this dam structure has been estimated at $696,000.

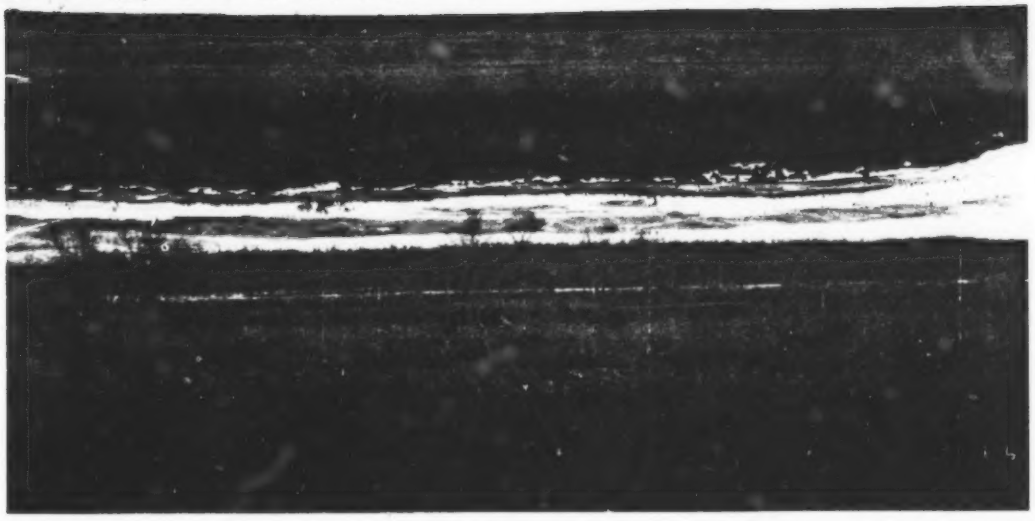


PHOTO ONE: R3-1 looking southwest on axis of upstream location of relocated Primary Grid #606. Causeway with bridge will be 13 metres above valley floor.
(Photo courtesy SBDA)

PHOTO TWO: R3-2 looking southwest on axis of upstream location of relocated Primary Grid #606. Dr. Mainprize golf course in foreground.
(Photo courtesy SBDA)

PHOTO THREE: R3-3 existing E-W Grid road crossing Dead Lake Channel looking east. Dead Lake is visible in distant right.
(Photo courtesy SBDA)

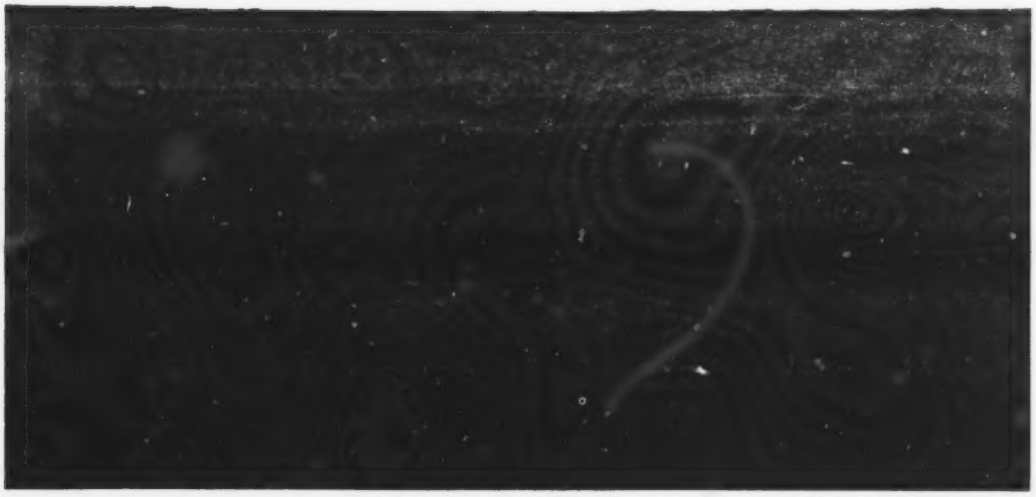


PHOTO FOUR: R3-2 looking southwest on upstream axis of Primary Grid #606 causeway/closure dam across Dead Lake Channel. Note pipeline route on right.
(Photo courtesy SBDA)

R5 - Primary Grid #705 Causeway across the Souris River Valley

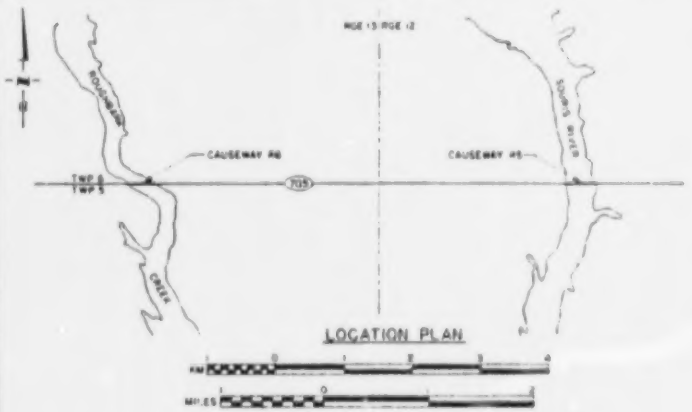
This Primary Grid Road is the major east-west route between Goodwater and Midale or Halbrite. It is also the main access to the Lomond #1 PFRA Community Pasture headquarters. The Authority recognizes the importance of this Grid Road and will undertake all required measures to ensure that it remains unaffected by the Rafferty Reservoir.

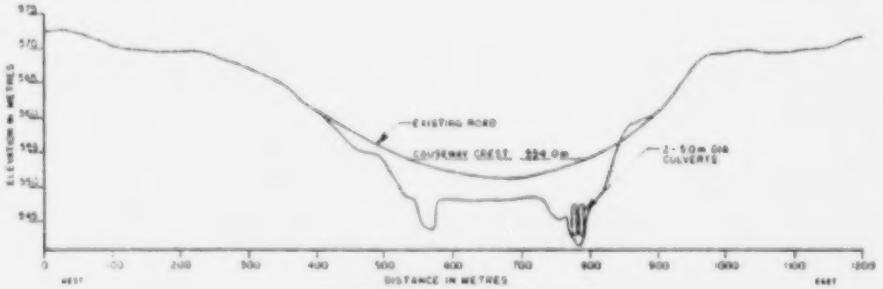
This existing Primary Grid was straightened during reconstruction in 1986. Two five metre diameter culverts were installed under the new grade within the Souris River channel. As the existing roadway would be inundated by the Rafferty Reservoir during flood control surcharges, the existing grade requires raising and rip-rap protection. Because of the shallow depth of the causeway, 2:1 side slopes are proposed. The culverts would be extended eight metres. Evaluations of these capital costs included weirs or gated control structures to hold the upstream impoundment at constant elevation, Full Supply Level. This will create permanent wetlands in the upper reaches of the reservoir and prevent exposure of the lake bottom during periods of reservoir drawdown.

The estimated cost of raising and graveling #705, extending the culverts, installing guardrails and water control structures and rip-rapping all exposed surfaces is $516,000.

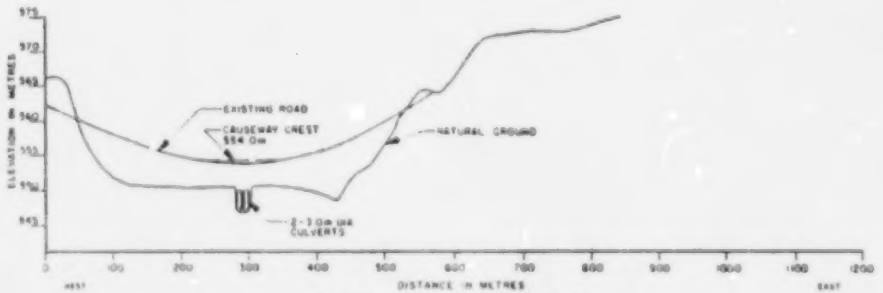
R6 - Primary Grid #705 across Roughbark Creek

As with R5 above, this new grade will require raising above the Maximum Flood Level with a 9.2 m extension of the two 3 m diameter culverts. 2:1 side slopes with rip-rap protection are proposed. The $277,000 cost estimate has included the possible provision of water control structures as well. Figure 16 illustrates the location, profiles and cross-sections of the causeways at locations R6 and R5 on #705.





CENTRE LINE OF CAUSEWAY R5



CENTRE LINE OF CAUSEWAY R6

TYPICAL CAUSEWAY SECTION

NTS

FIGURE 16

| | | |

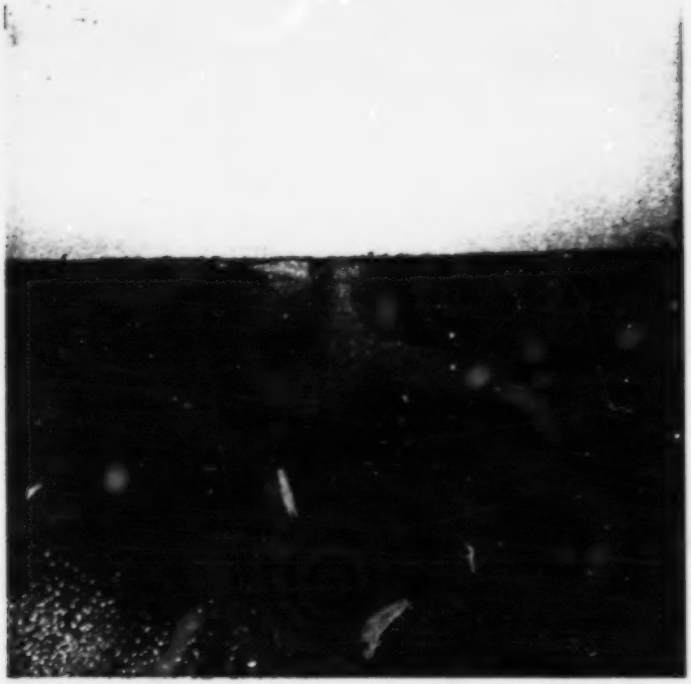


PHOTO FIVE: R-5 looking east on Primary Grid #705 across Souris River. Roadway straightened during reconstruction in 1986. Grade will be raised approximately 3.5 metres.

(Photo courtesy SBDA)

PHOTO SIX: Two 5 m diameter culverts through #705 grade across Souris River at R-5. Causeway will be raised and rip-rapped to protect against wave action during surcharges of Rafferty Reservoir.

(Photo courtesy SBDA)

R7 - Grid Road West of Halbrite

Field surveys have indicated that the Rafferty Reservoir will not affect this road, even during Maximum Flood Control surcharges. Mitigation is therefore not required at this site.

Other Roads

The Authority has concluded that the existing north-south farm access road across the mouth of Roughbark Creek does not warrant mitigation. Due to the pattern of settlement, land use and land ownership, now and in the future with the Rafferty Reservoir, a crossing at this location will not be required. The loss of the east-west farm access road across the Souris River immediately north of the Midale SDA Community Pasture will not be mitigated for the same reasons.

SUMMARY OF PROPOSED MITIGATION, RAFFERTY PROJECT AREA

Location	Amount ($1987)
R1 - Paved roads from Highway 18 and Highway 39 to Rafferty Dam Site "C"	1,466,000
RR - C.P. Railway relocated	571,000
R2 - Macoun-Outram Grid	nil
R3-1 - Mainprize causeway perpendicular to the Souris Valley with a 76 m bridge and paved roads to R3-2 and Primary Grid #606	2,796,000
R3-2 - Dead Lake Channel downstream Dam	1,149,000
R3-3 - Gravel road from the Macoun West Grid to #606	275,000
R4 - Dead Lake Channel Upstream Dam	696,000
R5 - Primary Grid #705 causeway on the Souris River to raise existing road	516,000
R6 - Primary Grid #705 causeway on Roughbark Creek to raise existing road	277,000
R7 - No work required on the grid road west of Halbrite	nil
Sub-Total	$7,746,000

Add 10% allowance for unforeseen costs	774,600
plus 10% allowance for Engineering costs	852,060
TOTAL Estimate Rafferty Roads/Causeways	$ 9,372,660

B. Alameda Project Area

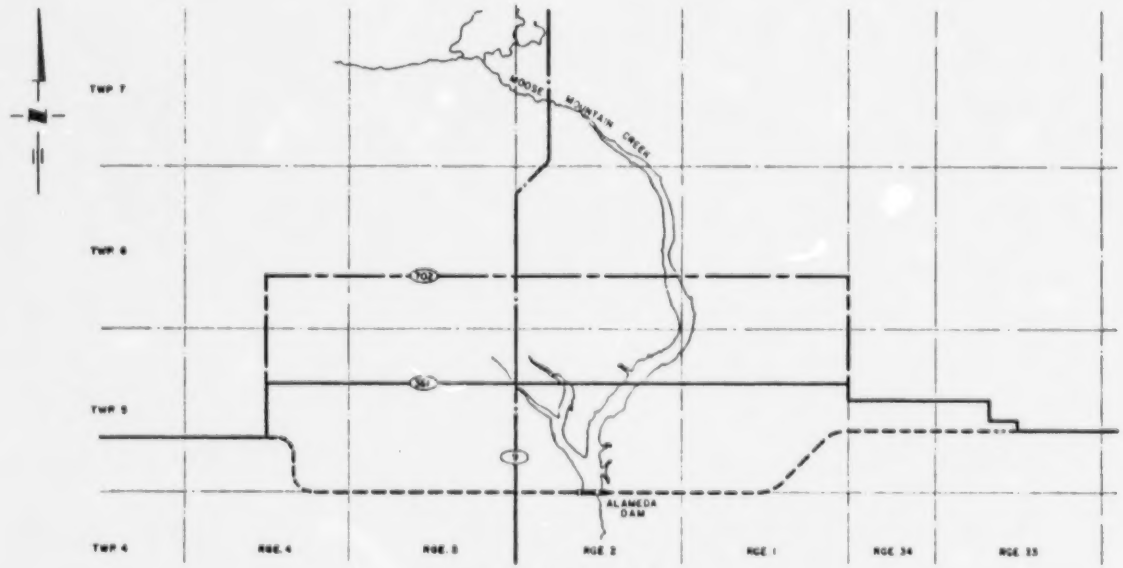
A-1 Rerouting of Highway #361

As discussed above, the Alameda Reservoir will affect a number of north-south and east-west roadways, almost exclusively within the Rural Municipality of Moose Creek. There have been preliminary discussions between Saskatchewan Highways and Transportation and municipalities with respect to the possibility of relocating a major portion of the highway between Lampman and Alida. This proposal would involve movement of Highway #361 6.4 km south of its present alignment to cross over the Alameda Dam and spillway (Figure 17). This relocation of #361 would not be considered as a direct cost to the Project as reconstruction of the highway is proposed regardless. Indications from Saskatchewan Highways were that they would incur all costs of re-routing Highway #361 immediately south of the Alameda Reservoir however additional costs for crossing the dam and spillway would be Project costs. Any decision to relocate #361 however, must be made in conjunction with all other road mitigation proposals associated with the Alameda Reservoir.

Based upon the evaluation of various options considered by Saskatchewan Power Corporation in their preliminary cost estimates, the Authority proposed to undertake the following roadway mitigation program, with the approval of the local municipalities:

A2-2 East-West #702 Primary Grid Road

At the present time, there are five east-west roads crossing Moose Mountain Creek within twelve miles of the Alameda Project Area. The two major arteries are Highway #361 and Primary Grid #702. With #361 being moved south to cross at the damsite, the Authority proposed to retain #702 at or near its present location. Three optional cross-sections were evaluated at the present location (A2-1) and for an alternative alignment 0.8 km north where the valley is approximately half as wide (A2-2) (Figure 18). A bermed cross-section at the more northerly crossing site was selected, utilizing a bridge in the central



HWY. 361 REROUTING PLAN

KM 0 1 2 3 4 5 6 7 8 9 10 11 12

MILES 0 1 2 3 4 5 6

LEGEND

- HWY. NO. 9
- EXISTING HWY. NO. 361
- NORTHERN ALTERNATE ROUTE
- SOUTHERN ALTERNATE ROUTE

NOTES:

1. SASK. HWYS. AND TRANSPORTATION WILL NOT BE IN A POSITION TO FINALIZE HWY. 361 REROUTING PLANS UNTIL PLANS FOR ALAMEDA DAM RESERVOIR AND CAUSEWAYS HAVE BEEN PUBLICLY ACCEPTED FOLLOWING THE ENVIRONMENTAL IMPACT STATEMENT HEARINGS.

FIGURE 17

DEPT	APP'D	REV.
		A

OTHER ENG. CHECKS
DEPT
CHK'D BY
DATE

DRAFTING DEPT
DRAWN BY D. KOZAK
CHK'D BY
DATE 97.05.29

SCALE

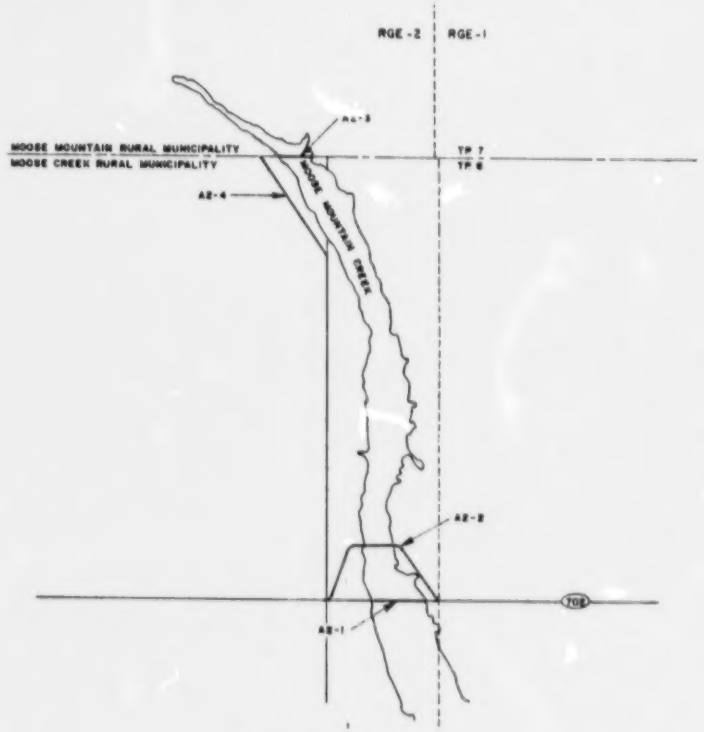
DESIGN DIVISION
DEPT
DESIGNED BY
CHK'D BY
APP'D BY
DATE

SOURIS BASIN DEVELOPMENT AUTHORITY

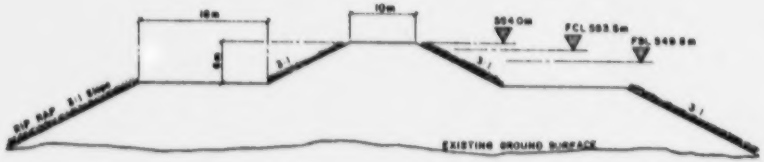
RAFFERTY / ALAMEDA PROJECTS

ALAMEDA DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY A1

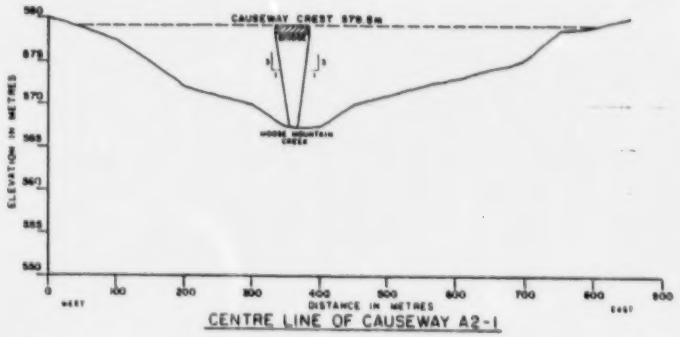
PROP	UNIT	SYST	FUNC	SERIAL	REV
A436	140		RVR	002	A



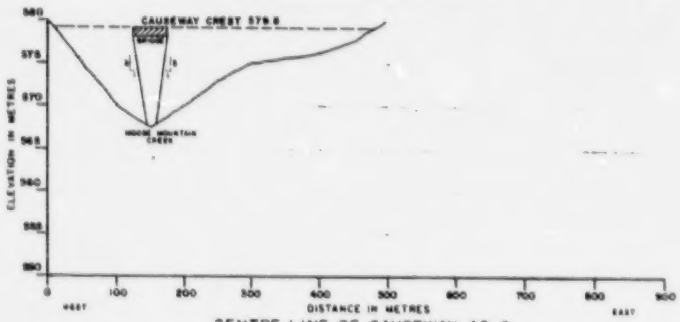
LOCATION PLAN



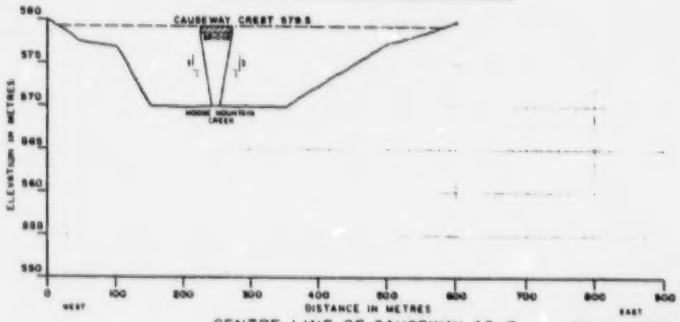
TYPICAL CAUSEWAY SECTION



CENTRE LINE OF CAUSEWAY A2-1



CENTRE LINE OF CAUSEWAY A2-2



CENTRE LINE OF CAUSEWAY A2-3

FIGURE 18

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																DRAFT		MTS	87-03-20
		REV.				REV.				REV.				REV.					

REV. A

OTHER ENG CHECKS	DRAFTING DEPT
DEPT	DRAWN BY MTS
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DATE	DATE 87-03-20
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DATE	DEPT
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DATE	APP'D BY
DEPT	DATE
CHK'D BY	
DATE	

SOURIS BASIN DEVELOPMENT AUTHORITY

RAFFERTY / ALAMEDA PROJECTS

ALAMEDA DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY A2's

PROP	UNIT	SYST	FUNC	SERIAL	PL
A436	140		RVR	003	A

section to permit boat passage. With the 2.5 km of connecting roads, this causeway is estimated to cost $1,375,000. This includes all costs fo fill, rip-rap, bridge, guardrails and road surfacing.

A2-3 Grid Road Between R.M. of Moose Creek and R.M. of Moose Mountain

Two optional cross-sections were evaluated at this location, ranging from approximately $1.73 million to $2.74 million (Figure 18). Current average annual traffic volumes are forty to fifty vehicles per day. With the proposal to retain #702 as the major reservoir crossing 5.6 km further south, the Authority believed this expenditure would be unwarranted.

A2-4 North-South Access, R.M. Boundary Grid to A2-2 Causeway

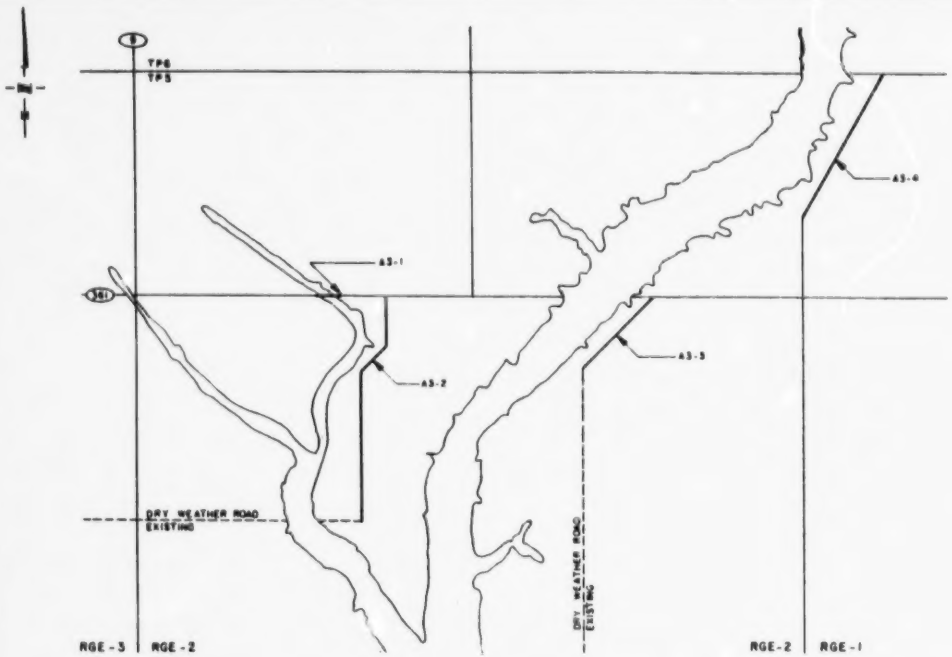
Approximately 1.6 km of Farm Access gravel road will be reconstructed along the west side of the reservoir, south of the R.M. Boundary Grid (Figure 18). This road connection will facilitate access to the reservoir crossing 5.6 km south. The estimated cost is $88,000.

A3-1 Highway #361 Causeway across Western Arm of Reservoir

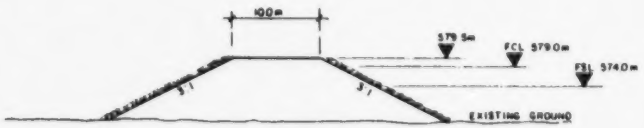
To facilitate access into the land area between the main reservoir in the Moose Mountain Creek Valley and the smaller western tributary, Highway #361 must be raised above the Maximum Flood Control Level of the Reservoir (Figure 19). This causeway will require 100 m of 3 m diameter culvert as well as rip-rap protection of the 3.1 side slopes. Total estimated cost is $892,000.

A3-2 North-South Farm Access Road South of #361

As the north-south access into the peninsula between the two arms of the proposed reservoir, the Authority will construct 3.5 km of farm access road along the east side of the westerly arm of the reservoir (Figure 19). This road will be graded and graveled at an estimated cost of $193,500. This road will replace the east-west and north-south farm access roads across the westerly arm of the reservoir.

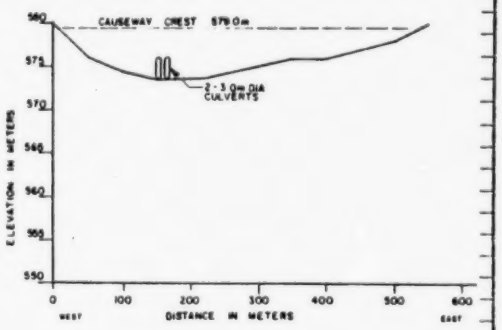


CAUSEWAY & ACCESS ROAD LOCATIONS

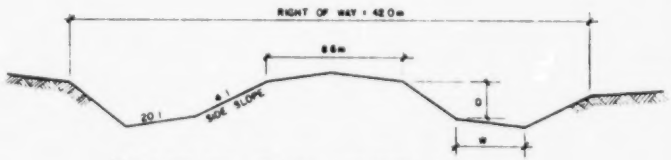


TYPICAL CAUSEWAY SECTION

MAX HEIGHT LESS THAN 60m



CENTRE LINE PROFILE OF CAUSEWAY A3-1



'D' LESS THAN 2.0m TOP = 8.6m SIDE SLOPE = 4:1
'D' FROM 2.0m TO 4.0m TOP = 8.6m TOE OF SLOPE 80m FROM SHOULDER
'D' EXCEEDS 4.0m TOP = 9.6m SIDE SLOPE = 2:1

TYPICAL ACCESS ROAD SECTION

NTS

FIGURE 19

DEPT	APP'D	REV
DEPT	APP'D	REV
DEPT	APP'D	REV
DEPT	APP'D	REV
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DATE 17/9/82

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SOURIS BASIN DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS
ALAMEDA DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
CAUSEWAY A3's

PROP	UNIT	SYST	FUNC	SERIAL	REV
A436	140		RVR	004	A

A3-3 Northeast-Southwest Connection to existing #361 on the Southeast Side of the Reservoir

Approximately 1.6 km of graded and graveled farm access road will be required to replace the existing road which will be inundated (Figure 19). Total estimated cost of this road is $88,000.

A3-4 Northeast-Southwest Connecting Roadway Along East Side Of Reservoir

Approximately 2 km of farm access road will be reconstructed and graveled to connect the existing north-south township roadway with the existing east-west township roadway (Figure 19). Total estimated cost is $110,000.

A3-5, A3-6 and A3-7

As indicated in Table 3, causeways at these three locations were estimated to cost an additional $11,649,000 assuming the bermed sections were required. The Authority considered these costs could not be justified relative to the low average annual traffic volumes.

SUMMARY OF PROPOSED MITIGATION, ALAMEDA PROJECT AREA

A1 - Relocation of Highway #361	no cost
A2-2 - #702 Causeway and bridge 0.8 km north of existing alignment	$1,375,000
A2-4 - Connecting Gravel road from R.M. Boundary Grid to north-south road to #702	88,000
A3-1 - Causeway on #361 across western arm of reservoir	892,000
A3-2 - Gravel farm access road connection to #361	193,500
A3-3 - Gravel farm access road from #361 east of reservoir	88,000
A3-4 - Gravel farm access road connecting north-south and east-west township boundary roads	110,000
Sub-Total	2,746,500
Add 10% allowance for unforeseen costs	274,650
Add 10% for Engineering costs:	302,115
TOTAL Estimate Alameda Roads/Causeways	$3,323,265

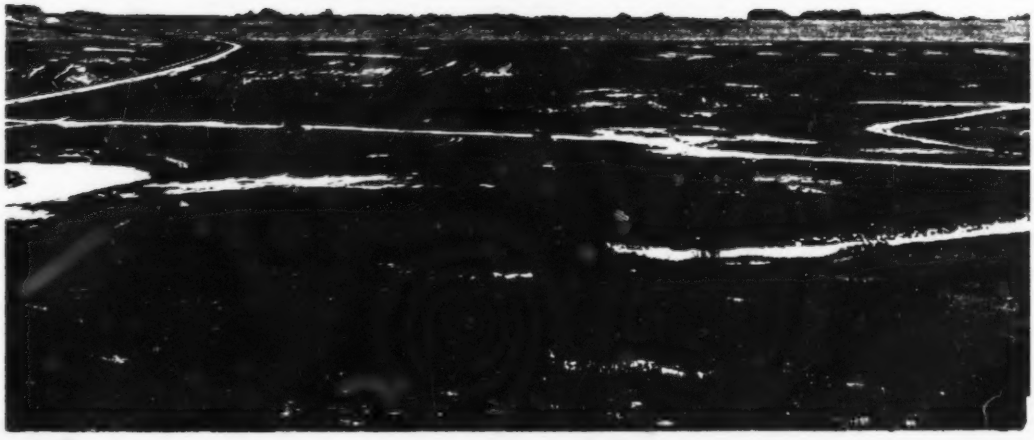

PHOTO SEVEN: Alameda Dam Site looking west. Axis is in center of photograph.
(Photo courtesy SBDA)

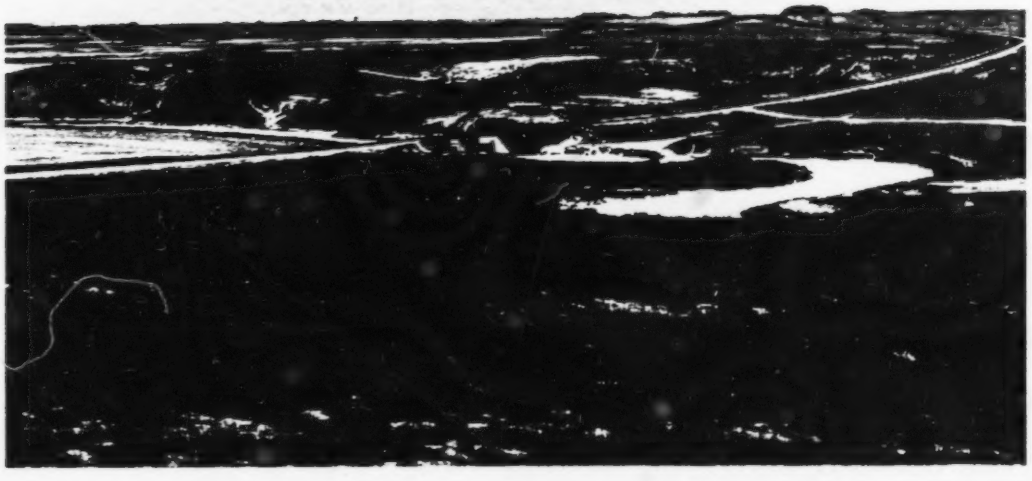

PHOTO EIGHT: Existing Grid Road and bridge across Moose Mountain Creek, immediately downstream from proposed Alameda Dam Site (Photo Seven).
(Photo courtesy SBDA)

PHOTO NINE: A-3 looking East on Highway 361 across western arm of reservoir. Roadway must be raised to accommodate flood control levels.
(Photo courtesy SBDA)

PHOTO TEN: A3-2 looking north to Highway 361. This Farm Access Road must be relocated to connect to #361 east of farmstead shown.
(Photo courtesy SBDA)

PHOTO ELEVEN: A3-3 looking north on Farm Access Road toward Highway #361. North-south Farm Access Road must be relocated along east side of Reservoir at this point.

(Photo courtesy SBDA)

PHOTO TWELVE: Looking west at crossing of Highway 361 over Moose Mountain Creek. This Highway will be relocated south of the Alameda Dam Site 6.4 km south.

(Photo courtesy SBDA)

PHOTO THIRTEEN: Looking west at Grid Road crossing of Moose Mountain Creek 3.2 km north of Highway 361. It is proposed that this road will be closed.
(Photo courtesy SBDA)

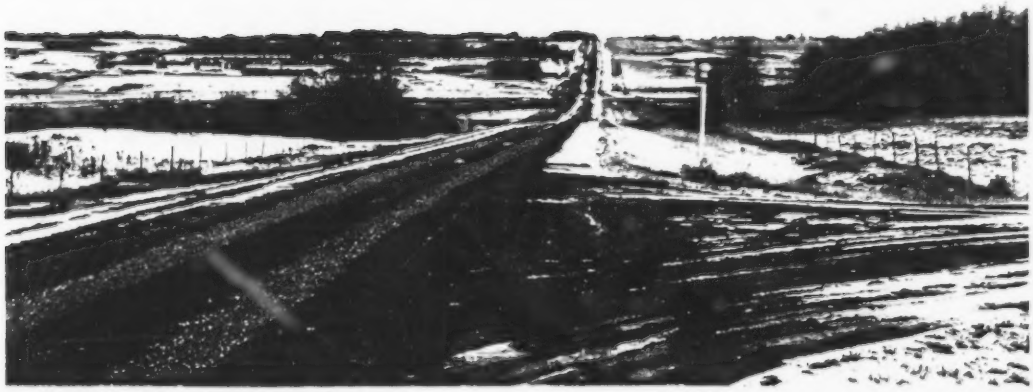

PHOTO FOURTEEN: A2-1 looking west on Grid Road (#702). It is proposed to relocate causeway and bridge 0.8 km upstream where Moose Mountain Creek Valley is narrower.
(Photo courtesy SBDA)

CONCLUSION

The combined Total Mitigation Costs for Rafferty and Alameda roads and causeways are estimated at $12.7 million based on the proposed program for each area.

Rafferty Project Area:	$ 9,372,660
Alameda Project Area:	3,323,265
TOTAL	$12,695,925

The recommended options for roads and causeways considered existing and future traffic patterns and volumes and the cost estimates for the various alternatives. These cost estimates are prefeasibility only, as they were based upon preliminary field investigations and limited topographic and soils data. Detailed geotechnical investigations should be undertaken prior to any further cost estimating and design or construction for each recommended option. The recommended options for roads and causeways considered existing and future traffic patterns and volumes and the cost estimates for the various alternatives. The final selection of roadway mitigation options will follow discussions with the local Rural Municipalities involved.

APPENDIX 1: S.P.C. METHODOLOGY, DESIGN PARAMETERS, AND UNIT COSTS

8.0 Discussion

8.1 Methodology

Tne various causeway options for each Reservoir were plotted on 1:50,000 scale drawings as general location maps. Each option was then located on 1:5000 scale 1m contour interval maps.

Profiles of each causeway and roadway were drawn from the 1:5000 maps for each option.

Design parameters and unit costs were developed from the reference information and applied to the causeway profiles and road lengths. Construction quantities and costs were then calculated.

C.P. Railway costs were developed from information provided by C.P. Rail for the trackage and in-house calculations of earthworks required.

8.2 Causeway Drawings

Drawings. illustrating causeway location plans, profiles, cross-sections, bridges and various other details are included in the discussion Section 8.5.

8.3 Design Parameters

Design parameters were developed from reference information received from discussions with Souris Basin Development Authority, Saskatchewan Highways, Rural Development, Armco Westeel, C.P. Rail and Robert Allan Ltd. This reference information is contained in Appendix "C".

8.3.1 Structure

The causeways and roadways would be earth filled structures. All roadway and causeway locations would be founded on till or alluvium foundations. Earth construction would be the most economical considering the availability of construction materials.

8.3.2 Crest Heights

Causeway crest heights would be 0.5 m higher than flood control level. This was a preferred parameter. Rafferty and Alameda Causeway Crest Heights would be 554.0 m and 579.5 m respectively. Dead Lake Dam Crest Heights would be 554.5 m, 1.0 m higher than flood control level, to allow freeboard.

8.3.3 Crest Width

The crest width preferred in the Terms of Reference was 10 m. This exceeds normal primary grid road standards as well as low standard highways and provides sufficient width for guard rails. Typical highway cross-sections are provided in Appendix-'C'.

8.3.4 Surfacing

The surfacing would be graveled surface similar to a primary grid road surface or low standard pavement when required.

8.3.5 Cross Section Slopes

The fill slopes would be 3H:IV for fill heights less than 6 metres. For fill heights exceeding 6 metres, the upper 6 m of fill would have slopes 3H:IV and the fill below 6 m would be bermed to an effective slope of 6H:IV with a 3H:IV berm face slope. The 3H:IV fill slopes concur with standard practices of Saskatchewan Highways, Rural Development and Saskatchewan Power. The bermed cross-section to an effective 6H:IV slope was developed from discussions with Cochrane Lavalin, who are designing the Rafferty and Alameda Dams.
Typical highway Cross Section slopes and a discussion of the effective 6H:IV bermed slope is in Appendix-'C'.

8.3.6 Slope Protection

Slope protection will consist of rock rip rap on all water exposed slopes placed on a granular filter material. Discussions with Cochrane Lavalin indicated a 0.6 m rip rap blanket would be required.

8.3.7 Bridges

The bridges would be precast concrete decking on piles. Saskatchewan Highways and Rural Development provided design drawings as contained in Appendix-'C'

8.3.8 Culverts

The culverts would be corrugated steel pipe or plate steel pending size requirements. Armco Westeel provided details as contained in Appendix-'C'.

8.3.9 Guard Rails

The guard rails would be w-beam steel rails on wood posts. Rural Development provided photographs illustrating a recent guard rail installation. Guard rails would be installed along both sides of the causeway only along the F.S.L. limits.

8.4 Unit Costs

Unit costs were developed from reference information in Appendix-'C', Table No. 3 - "Unit Costs" summarizes the unit costs used in this report.

8.4.1 Earth Work Costs

Excavation, fill, rip rap, filter material and topsoil stripping unit costs were obtained from Cochrane Lavalin's estimates for Rafferty Dam. Unit costs compare reasonably with similar works done by Saskatchewan Power. The stripping was assumed to be a very wet excavation.

8.4.2 Grassing Costs

The grassing unit cost was obtained from the Saskatchewan Power Nipawin Hydro Electric Project costs. That work involved grassing the downstream face of Francois Finlay Dam.

8.4.3 Surfacing Costs

Surfacing costs were obtained from Saskatchewan Highway's information.

8.4.4 Roadway Costs

The roadway subgrade unit cost was obtained from Saskatchewan Highways. They provided unit costs for several types of highways. These costs compared reasonably with Rural Development costs.

8.4.5 Bridge Costs

Bridge costs were provided by both Saskatchewan Highways and Rural Development. The unit costs were comparable.

8.4.6 Culvert Costs

Culvert costs were developed from information provided by Rural Development and Armco Westeel. The unit cost varies pending the culvert sizing and structure. In being consistent with the prefeasibility nature of this report, the unit prices provided were rounded conservatively.

8.4.7 Guard Rail Costs

Guard rail costs were provided by Saskatchewan Highways and Rural Development. They compared reasonably.

8.4.8 Ferry Costs

Ferry costs were provied by Saskatchewan Rural Development and Robert Allan Ltd. (Naval Architects and Engineers - Britsh Columbia). Robert Allan's costs were cross-checked with Manitoba Department of Highways and Ferrry Builders.

8.4.9 Culvert Gate Structures

Estimated costs were provided verbally by Armco. This would be relatively the same cost as installing a concrete wier upstream of the culverts.

8.4.10 Railway Trackage

This cost was provided in full by Canadian Pacific Railway.

Table No. 3

Rafferty/Alameda
Causeways

Unit Costs

Item	Description	Unit	Unit Cost
1.	Excavation and Fill	m^3	$ 4.70
2.	Riprap	m^2	$ 30.00
3.	Filter Material	m^3	$ 25.00
4.	Stripping	m^3	$ 4.85
5.	Grassing	m^2	$ 1.85
6.	Paved Surface	km	$ 42 000.00
7.	Gravel Surface	km	$ 5 000.00
8.	Paved Roadway	km	$106 000.00
9.	Gravel Roadway	km	$ 55 000.00
10.	Bridge	m^2	$ 1 000.00
11.	CSP Culvert (1m Diam.)	m	$ 1 000.00
12.	CSP Culvert (3m Diam.)	m	$ 2 500.00
13.	Plate Culvert (5m Diam.)	m	$ 5 000.00
14.	Guard Rails	m	$ 85.00

Note: CSP = Corrugated Steel Pipe